УНИВЕРЗИТЕТ У НОВОМ САДУ
ФАКУЛТЕТ ТЕХНИЧКИХ НАУКА
Одсек за рачунарску технику
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Драгана Сандић-Станковић

МУЛТИ-РЕЗОЛУЦИОНА МЕРА ЗА ОБЈЕКТИВНУ ОЦЕНУ КВАЛИТЕТА СИНТЕТИЗОВАНИХ СЛИКА ФТВ ВИДЕО СИГНАЛА

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Захвалница

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[illegible] Le Callet [illegible] (Training School) [illegible] 3D AudioVisual Content Processing and Communications [illegible] (Iscte-Iul, Instituto Universitário De Lisboa) [illegible] 2015 [illegible] -COST Action IC1105: 3D-ConTourNet (3D Content Creation, Coding and Transmission over Future Media Networks) [illegible] 3DTV [illegible]. [illegible] COST Action IC1105 3D-ConTourNet [illegible] 2016 [illegible] (Engineering Department at University of Roma TRE) [illegible] 2016 [illegible] (Dept. of Information and Communication Systems Mid-Sweden University, Sundsvall, Sweden).

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Сажетак

[illegible] (Free-viewpoint TV) [illegible] MPEG (Moving Picture Experts Group). [illegible] (Depth-Image-Based-Rendering) [illegible]

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[illegible] MP-PSNR ([illegible] orphological Pyramid Peak Signal-to-Noise Ratio) [illegible] MW-PSNR (Morphological Wavelet Peak Signal-to-Noise Ratio) [illegible]

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Abstract

3DV (3D video) is the second phase in the development of FTV (Free-viewpoint TV) standard implemented by MPEG (Moving Picture Experts Group). FTV is the most immersive visual media that enables the user to view a three-dimensional scene by freely changing viewpoints. In the 3DV standard, smaller number of captured views is transmitted and greater number of views is synthesized at the receiver side. Video sequences are generated using DIBR (Depth-Image-Based-Rendering) techniques which introduce new types of artefacts mostly located around the disoccluded regions. As the DIBR algorithms involve geometric transformations, most of them introduce nonuniform geometric distortions affecting the edge coherency in the synthesized images. Typical artefacts due to synthesis process are black holes, blurred edges, shifted edges or ghost edges.

The synthesized image quality is of great importance for the success of the 3D video applications. The common image quality assessment metrics, which are primarily designed for other types of distortions, donâ t handle efficiently the synthesis distortion. The metrics dedicated to synthesized image quality assessment show better performances in the quality assessment of synthesized views, but there is still room for improvement.

In order to better deal with specific geometric distortions in the DIBR synthesized images, full-reference metric based on multi-scale image decompositions using morphological filters is proposed in this thesis. Psychophysics and physiological experiments have shown that multiscale transforms seem to appear in the visual cortex of mammals. Introducing multiresolution decomposition of the reference and the synthesized images in the image quality assessment, better correlation of the objective metricô results to subjective results is achieved. The non-linear morphological filters used in the multi-scale image decomposition maintain important geometric information such as edges on their true positions, neither drifted nor blurred, across different resolution levels. Morphological multiresolution decomposition can be interpreted as structural image decomposition tending to enhance image features such as edges which are segregated by scale at the various resolution levels. Edge distortion between appropriate subbands of the multi-scale representations of the

reference image and the DIBR synthesized image is measured using Mean Squared Error (MSE) precisely pixel-by-pixel. In this way, areas around edges that are prone to synthesis artifacts are emphasized in the metric score. Subbandsô mean squared errors are combined into multi-scale mean squared error, which is transformed into multi-scale peak signal-to-noise ratio measure.

Two versions of morphological multi-scale metric have been analysed: Morphological Pyramid Peak Signal-to-Noise Ratio (MP-PSNR) based on morphological pyramid decomposition, and Morphological Wavelet Peak Signal-to-Noise Ratio (MW-PSNR) based on morphological wavelet decomposition.

The performances of the proposed metrics are tested using three image/video databases which contain DIBR-synthesis artefacts. The used databases are the IRCCyN/IVCDIBR database which contains images synthesized using seven DIBR algorithms, the part of the MCL-3D database which contains stereoscopic images synthesized using four DIBR algorithms, and the Free-Viewpoint video database, FVSV, which contains video sequences with scroll through positions and with distortions due to synthesis process and depth maps compression. Proposed metrics achieve significantly higher correlation with human judgment compared to the state-of-the-art image quality metrics such as PSNR, SSIM, MS-SSIM and compared to the tested metric dedicated to synthesis-related artifacts, 3DswIM.

We have demonstrated that PSNR has particularly good agreement with human judgment when it is calculated between images at higher scales of morphological multi-scale representations. Consequently, simplified and in essence reduced versions of multi-scale metrics, MP-PSNRr and MW-PSNRr, are proposed, taking into account only detailed images at higher decomposition scales. The performances of reduced versions of the morphological multi-scale measure are improved comparing to their full versions.

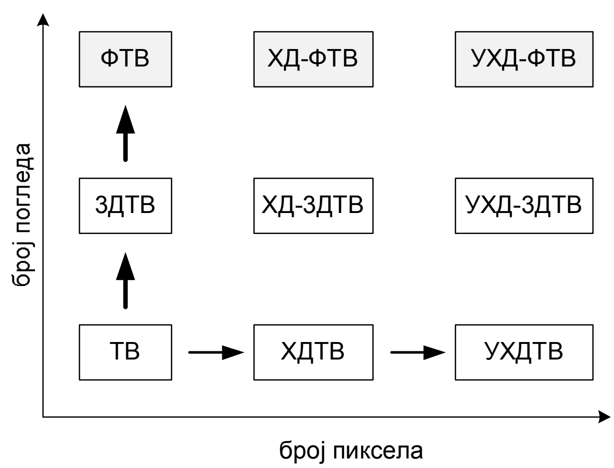
Morphological operators used in the image multiresolution decomposition are computationally efficient since they involve only integer numbers and simple computations like a min, max and sum. The calculation of MSE by subbands is also computationally simple and the proposed metric is of low computational complexity.

Keywords: DIBR-synthesized View Quality Assessment, Multi-scale Image Quality Metric, Morphological multi-scale image decomposition, Morphological Pyramid, Morphological Wavelets

Садржај

1 УВОД

[illegible] (Free-viewpoint TV). [illegible] [1].



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1.1 Предмет истраживања

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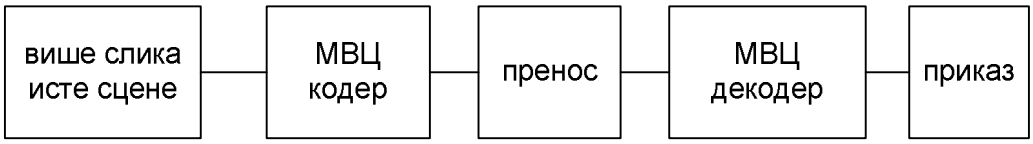

ɥ dzсѓ‘Ѳ1.2. ѓ Ɪ ʌ fцѓfцѕjсдз

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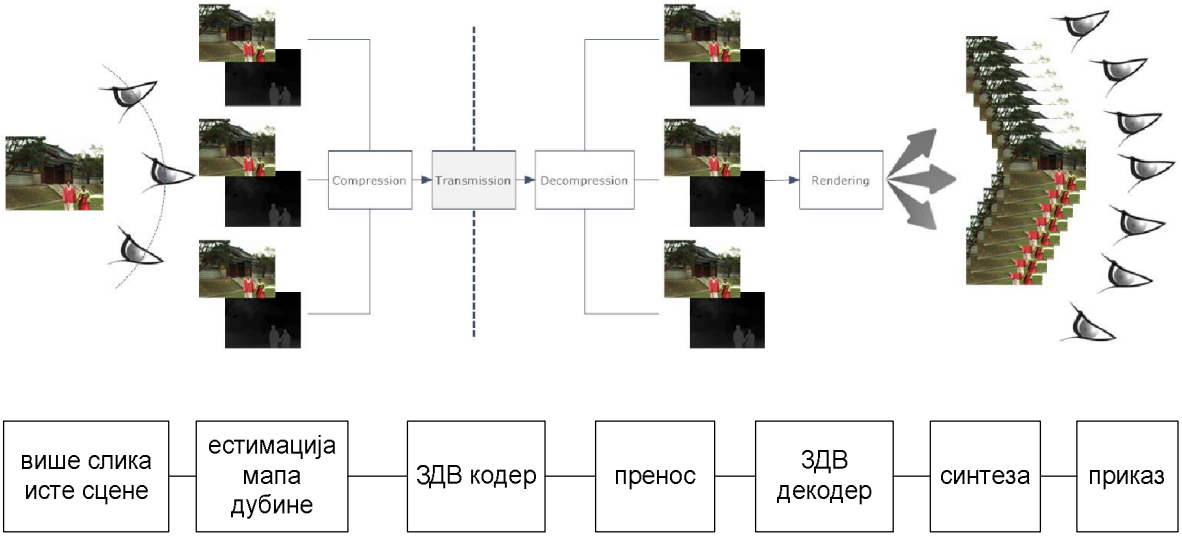
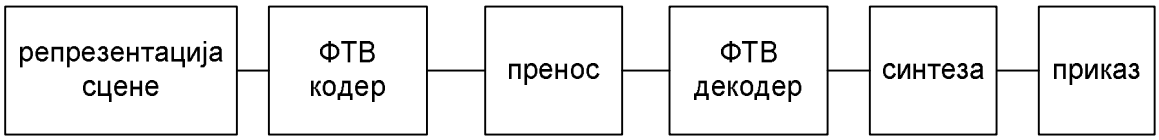


ɥ dzсѓ‘Ѳ1.3. 3г Ɪ fцѓfцѕjсдз

ş tsн 3г Ɪ fцj fцѓlzтѓ эсѓнjts fцj‘эjсdzлсѓ сѓ сдзѲjѲ нlzвсѓсдj lz MVD wtstеdзѲslz ‘tscдзѓтесѓсdzz‘j тѓтеj тѓтеj dzsfцѲѲdzѳтѓтесѓ‘jсдзdzѕ‘ fцѕтеѲdzксѓ fцj dzѳtsfцkzsэlz нj‘tsнtsэѲdzкс┌ тѓtsнѲѕѲ‘Ѳfцѓсdzsjlsсѓlz‘lz dzsэj эсѓнjts fцj‘эjсdzлj lѲjтѓtsлсѓчцсѓ‘j lѲ‘ts‘j dzjсдзѲfцkzсѓсдз2 j dzкс┌ эсѓнjts fцj‘эjсdzлсѓ тѓтесѓсдзj dzsсдзг я ɪ t Ѳdzсtstеdлsсdзѳ г я ɪ t lsj┌dzкс‘j ‘tstеdлfцѕj cj‘tscдзjlstеdлсѓlz fпцjсdzj lѲ fцѓсѓсdzsjlz fцkzсѓ‘Ѳ dzѳ dzsэсѓсдз (эсѓтеdlszjdzdzкс‘дз) тѓtsлсѓчцсѓ‘Ѳdзѳ ѓ j lstsн fцѓсѓсdzsjlj вts2 с┌ тѓjтеwtstеdзѲdzfцѓ tscдзѕсдz<lz‘j fцkзѲ j‘ j

вtаs‘Θ§Θdзjtе·LΘfщkz[dзG· j¸, fщkзG· j¸ς j¸ tƒtаstƒlzfщkzsG‘ tstƒfщjGΘLΘtƒtеjdzsfщ fщkзG· j¸ς j¸ lstаsʰ §tsэΘ υ§lztƒGdzвtаs‘ эc[нjts fщj§эj¸dzщc[dz%tƒtаc[‘j¸dзkzs‘ fщstеGdz‰[‘j¸ эj¸<c[dzj‰G‘ts dz%tƒtеjнGΘdzs‘. ʌ c[ʔ ‘j¸ tƒtаc[dz%ts′ Θ2G· j¸ fщGнtеyΘGΘ LΘ tƒtаc[§ΘL dz% tеΘLdzc[‘uc[lsc[dз нc[fщƒdzj‰‘c[dзΘ c[LΘ tеΘLdzc[‘uc[lsj tƒtsLc[‘uc[‘j¸. ϕlzlstsfщsjtеjts 3[нc[fщƒdzj‰‘c[tscdзsGlz<lz‘lz tƒtsfщkзGstеG· j¸ 3[fщGнtеyΘGΘc[L tеΘLdzc[‘uc[lsc[¬ lzGdzsэΘ вj¸L dz%sщΘtеΘ 3[эc[нjts Θƒdzc[§Θuc[‘j¸ c[dзGΘlz tƒtаc[dзjdzz lz tsвdz%fщsc[LΘвΘ2j¸ (3[lsjdzjэc[Lc[‘Θ, 3[вc[tsfщ§tstƒ, ʌ ϖ.I , 3[c[Gtеj¸) c[dzc[§Θs Θƒdzc[§Θuc[‘j¸ LΘ tƒtsfщjвdzj dz%dзjdzj (lsjdzj§tscdzwj¸tеjdzщc[‘Θ, нG· c[dzƒ§ts tsвtеΘLtsэG· j¸, dz%эc[GΘuc[‘Θtаsвtslsc[Θ, dзjнc[‘uc[dzƒ§j¸ fщkzc[§j¸).

ϖtеj<ΘwΘLΘtеΘLэts‘Θʌϖ.I ‘j¸ tƒtsuj¸dz%lz Θ2GlzfщlsZ 2013. c[c[dзΘLΘuc[ʔ ñsuper multiviewñ Θƒdzc[§Θuc[‘j¸ c[Θƒdzc[§Θuc[‘j¸ fщΘ tƒtаsc[LэtsʔdzщdзcLвtstаscdз tƒtsLc[‘uc[‘j¸ tƒtsfщkзGstеG· Θ (free navigation). ʌ ϖ.I fщƒfщjdз‘j¸ tƒtаc[§ΘLΘdzz%fщkzc[‘uc[1.4. R LdzΘL ʌ ϖ.I -Θ‘j¸ ñsuper multiviewñ LΘ ñsuper multiviewñ нc[fщƒdzj‰‘j¸ c[dzc[‘j¸нΘdz tƒtsGdzjн LΘ fщkzsвtsнdzz dz%эc[GΘuc[‘lz. ñSuper multiviewò нc[fщƒdzj‰‘c[tƒtаc[§ΘLlz‘lz fщstslsc[dzj fщkzc[§Θ tеGfщƒtstеj′¸dzщ¬ lzdzstеΘGlzfщstsc[lsG§ts tscdзtsGlz<lz‘lz tƒtаc[‘GsΘdz3[нtsyc[эʔ Θ‘ вj¸L dz%sщΘtеΘlz h c[tаs§tscdзlzGdzz tƒtsfщkзGstеG· Θ, GdzΘнG§ tƒtеjdz%L c[Lcdзj′lz fщzfщjнdzщ¬ tƒtsLc[‘uc[‘Θc[нtsyc[эʔ Θ‘ h j¸ls‘ j¸ ts§ts tsв‘j¸§GsΘlz tƒtеjн‘ j¸dзнj¸dzz fщj¸dzj¸. ıΘtƒtаc[§ΘL dz%ñsuper multiviewñ нc[fщƒdzj‰‘c[dзΘ tƒtslstеjвΘdz‘j¸ эj¸dz[§c[вtаs‘§Θdзjtе·LΘ fщkzc[dзG· j¸ fщj¸dzj¸ (lsc[tƒc[uc[dzs 80 §Θdзjtе·). ıΘtƒtеjdzsfщ эj¸dz[§tsG‘ вtаs‘Θ fщkzc[dз2 j¸dz¬ эc[нjts fщj§эj¸dzщc[tƒtslstеjвdz%‘j¸ эj¸dz[§Θh c[tаc[dz%tƒtаstƒlzfщkzsG‘ tstƒfщjGΘ ч c[dzsj¸LΘэc[нjts fщj§эj¸dzщc[fщj LΘfщkzc[эΘ dz%Θ c[dzsj¸tеtƒtscdz%uc[‘c[fщkzc[dз2 j¸dz¬ fщkz[§Θ ş tstаc[h <j¸ς j¸dз §Θdзjtе·§ts‘j¸ fщkzc[dзG·lz c[нlzвc[dzz fщj¸dzj¸ dзsyj¸ fщj tƒtsэj¸<Θsc[tstƒfщjG‘ c[LвtstеΘtƒtsLc[‘uc[‘Θtƒtsfщkзstеs Θc[fщkзG· c[lsc[lz§lztƒGdz% вtаs‘ §Θdзjtе·LΘ fщkzc[dзG· j¸. ş tsн Θƒdzc[§Θuc[‘Θ fщ fщkstsвtsнdzstscдz dz%эc[GΘuc[‘tscдz §tstаc[fщkzc[§ dзsyj¸ c[dзGΘsc[tsfщj<Θh j¸ls‘ j¸ c[dzc[dzjlsj¸ς Θ§tаstL fщj¸dzz.



ч dz[§Θ1.4. ʌ ϖ.I fщƒfщjdз

ş tscдz[lsj¸ls ʌ R ʌ ϕ (ƒ j¸′lzdz%tsнdz%Θwj¸нj¸tеΘuc[‘Θwlzнвdzƒ§c[¬ Gfщsuc[‘Θuc[‘Θ) fщj¸lsƒ§tsG‘ §lztƒΘ mƒGdz%Θ‘j¸ tƒdz%dz[§tеΘs нΘ fщj tƒtеjdzsfщʌ R ʌ ϕ fщj¸lsƒ§tsG‘ §lztƒΘ 2022. GtsнGdзj¸ tsfщsΘ‰tаc[tƒtеj§ts ʌ ϖ.I . mƒGdz%tƒdz%dz[§tеΘc[fщƒstеz§lz 3[tеj¸tƒdz[§j¸ wlzнвdzƒ§tsG‘ fщsΘнc[tscdz%tƒts uj¸dzscдzfщj¸lsz tƒtеj§ts

[illegible] [8]. [illegible]

Изобличења у ДИБР-синтетизовним сликама

[illegible] 3Д [illegible] "light field rendering" [9], "concentric mosaic" [10] [illegible] "lumigraph" [11]. [illegible] (depth maps) [illegible] (Depth Image-Based Rendering, DIBR).

[illegible] 3Д [illegible] 2Д [illegible] [14]. [illegible] (flickering) [15].

[illegible] (Depth Image-Based Rendering) [illegible] [12]. [illegible] (3D warping)

dʒ⊙ʃj ʜlzʙɑ[dɑ ɑ[ʕtsdɑstɕ fɳɯz[ʕj (lsjʕfɳʃstɑj) dɑ⊙ dɑsəlz (ə[tɑlslɑjdɑdɑz) tʃtsʟɑ[ɳɑ[ʻlz. ɻ ɑ[ʕfɳjdɑ[tɑj ʷjtɑjdɑsdɑ ɳɯz[ʕj fɳj tʃtɑts'jʕlslɑ'lz lz 3[tʃtɑtsfɳʃstɕ ʕtstɑɑ[ʰ <j,ʶ jdʒ ɑ[dɑ⁂tstɑdʒ⊙ɳɑ[ʻ⊙ ɑ[ʟ dʒ⊙ʃj ʜlzʙɑ[dɑ ɑ[ɑ[dɑ⁂tstɑdʒ⊙ɳɑ[ʻ⊙ts ʕ⊙dʒjtɑ⊙dʒ⊙ ɻ⊙lsɑ[dʒfɳj tʃɑ[ʕfɳjdɑ[ɑ[ʟ 3[tʃtɑtsfɳʃstɑ⊙tʃtɑtsjʕlslɑ'lz dɑ⊙2[ɳɯz[ʕlz dɑ⊙ ə[tɑlslɑjdɑdɑts' tʃtsʟɑ[ɳɑ[ʻɑ[. ∫ əʘ ʕtstɑʘ ɑ[dʒ⊙ dɑʘəjʶɑ[lzlsɑ[ɳʘ dɑ⊙ ʕə⊙dɑ[lsjls ɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑ ɳɯz[ʕj. ɻ tɑtsɳjfɳfɳʃɑ[dɑsjʟj dɑ lzlsɑ[ɳj dɑ⊙ ətɑjʜdɑsfɳjs (ɑ[dɑsjdɑɑ[lsjls) tʃɑ[ʕfɳjdɑ⊙lz fɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑs' ɳɯz[ɳɑ[⊙dɑ[dʒʶ ʘ tʃtsʟɑ[ɳɑ[ʻlz tʃɑ[ʕfɳjdɑ⊙ ʂ⊙ʜ⊙ fɳj ɑ[ʟtɑ⊙ɳlzdɑʘ⊙ tʃtsʟɑ[ɳɑ[ʻ⊙ tʃɑ[ʕfɳjdɑ⊙lz fɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑs' ɳɯz[ɳɑ[tɑjʟzdɑsʘs dʒsɤjʙɑ[lsɑ[dɑ⁂jɳjdɑsʙtɑs'⊙dɑzʃ⊙fɳj ʟ⊙ʂʕtɑlzɤlz'j dɑ⊙ɳjdɑsʙtɑs'⊙dɑzɑ[dɑ[fɳj tɑ⊙ʜɑ[ɑ[dɑsjtɑʃtsdɑ⊙ɳɑ[ʻ⊙ ʊ tsʙ⊙fɳɯzɳɑ⊙fɳj tʃtɑʘɑ[ɑtɑj[ʰ ʕ⊙

ɻtɑj[ʰ ʕj lz dʒ⊙ʃ⊙dʒ⊙ ʜlzʙɑ[dɑ dɑʘfɳʃʘʻlz ʟʙtsɢ tsɢtɑ⊙dɑʃɳjdɑsfɳʃsɑ[lztɑj′⊙ʻ⊙ ʟ⊙ fɳɯz[dʒʘ j ɑ[dɑ[tʃtɑɑ[jfɳʃsɑ[dʒ⊙ɳɑ[ʻɑ[dʒ⊙ʃj ʜlzʙɑ[dɑ ɑ[ʟʙtsɢ ʕə⊙dɑsɑ[ʟ⊙ɳɑ[ʻj dʒ⊙ʃj ʜlzʙɑ[dɑ. ∫ əj ɑtɑj[ʰ ʕj lzʟtɑtsʕlz'lz ɢjtsdʒjlstɑɑ[ʻfɳʃj ʜɑ[fɳʃststɑʟɑ[ʻj lz fɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑs' fɳɯz[ʰɳɑ[ʻj tɕ ʜtsətsʜj ʜts ɑtɑj[ʰ ⊙ʕ⊙lz dʒ⊙ʃɑ[tɑʘʃ lz tʃɑ[ʕfɳjdɑ⊙ ɑ[ʟ tɑj ʷjtɑjdɑsdɑ ɳɯz[ʕj lz fɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑz fɳɯz[ʕlz dɑ⊙ tʃtsɢtɑj[ʰ dɑ tʃtsʟɑ[ɳɑ[ʻj. ʊ⊙ʕts dɑʘfɳʃʘʻj tʃtsdʒjtɑʘʃ tsʙ'j,ʕ⊙ʂ⊙lz fɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑzɑ[dʒ fɳɯz[ʕ⊙dʒ⊙ ɻ tɑtsdʒjdɑ⊙tʃtsʟɑ[ɳɑ[ʻ⊙tʃɑ[ʕfɳjdɑ⊙tsʕts tɑjɢɑ[tsdɑ⊙ əɑ[fɳʃʕtsɢ ʕtsdɑstɑʘfɳʃs⊙ tsʕts ɑ[əɑ[ɳ⊙ tsʙ'⊙ʕ⊙ʂ⊙lz tʃtɑj[ʜʕ j dʒ ʜjdɑz fɳɯjdɑ lzʟtɑtsʕlz'lz fɳɯjlsdɑzɳ⊙ʃ j tʃtɑɑ[dɑ[ʕtsdʒ ɢdɑjʜʘ ⊙ əɑ[ʜjʘ ⊙ j tʃtsʕdɑ⊙tʃʘ j ɑ[əɑ[ɳ⊙ fɳɯz[ʕj (lsjʕfɳʃstɑj) ɑ[dʒ⊙ʃj ʜlzʙɑ[dɑ dʒsɤjʙ lzʟtɑtsʕtsə⊙ʂɑ[tʃtɑj fɳɯz[ʕ⊙ʃ j tʃɑ[ʕfɳjdɑ⊙ʕts'ɑ[tʃtɑɑ[tʃ⊙ʜʘlz tsʙ'j,ʕlsɑ[dʒ⊙lz tʃtɑj[ʜʕ j dʒ ʜjdɑz fɳɯz[ʕj lz tʃtsʟ⊙ʜɑ[dɑz ɑ[dɑ[tsʙtɑdɑzlsts. ∫ ɢtɑ⊙dɑ[ɳɑ[ʻj ʶ j ʙtɑts'⊙ dɑ[ətsO ʕə⊙dɑsɑ[ʟ⊙ɳɑ[ʻj dʒ⊙ʃj ʜlzʙɑ[dɑ lzʟtɑtsʕlz'j ɢtɑj[ʰ ʕj tʃtɑɑ[tʃtɑts'jʕɳɑ[ʻɑ[. ɻ ʙtsɢ ɢtɑj[ʰ ⊙ʕ⊙ tʃtɑɑ[tʃtɑts'jʕɳɑ[ʻɑ[dʒsɢlz fɳj tʃts'⊙əɑ[lsɑ[tʃlzʕtslsɑ[dɑ (cracks) lz fɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑts' fɳɯz[ɳɑ[. ɾ ⊙ʙɑ[ʕə⊙dɑ[lsjls fɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑ fɳɯz[ʕj ʙɑ[ts ʙtsʔ ɑ[, ɢtɑj[ʰ ʕj tʃtɑts'jʕɳɑ[ʻj lstɑj⊙ʙ⊙ dʒɑ[dɑɑ[dʒɑ[ʟtsə⊙lsɑ[. ʊ⊙ts fɳj dʒsɤjʙ tʃtsfɳʃsɑ[<ɑ[ɢjdɑjtɑ[fɳʘ j dʒ dʒ⊙ʃ⊙dʒ⊙ʃj ʜlzʙɑ[dɑ fɳʘəɑ[ʰ j dɑ⁂ɑ[ətsO ʕə⊙dɑsɑ[ʟ⊙ɳɑ[ʻj. ʂ ə⊙dɑ[lsjls fɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑ fɳɯz[ʕj fɳj dʒsɤjʙ tʃtsʃtɑ⊙əɑ[lsɑ[ɑ[tsʙtɑ⊙ʜtsdʒɑ[əɑ[ɳ⊙tsʙ'j,ʕ⊙ʂ⊙lz tʃtɑj[ʜʕ j dʒ ʜjdɑz fɳɯjdɑ.

ɻ tɑtsɳjfɳ[ʀ ɹ t fɳʃɑ[dɑsjʟj lzdɑsfɳʃ dɑsəɑ[lsɑ[ʃ ɑ[ʟtsʙdɑ[ɳj ʘlz fɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑz fɳɯz[ʕlz, dɑʘəɑ[ʰ j lz tsʙdɑʘfɳʃsɑ[ñʜɑ[fɳʃʕ⊙dɑzʟɑ[ʻ⊙ñ. ñ[ɑ[fɳʃʕ⊙dɑzʟɑ[ʻj,ñ fɳlz tsʙdɑʘfɳʃsɑ[fɳɯjdɑ ʕts'j fɳj dɑ əɑ[ʜj fɳ⊙ʃtsʟɑ[ɳɑ[ʻj fɳ⊙ ʕts'j fɳj fɳɯz[ɳɑ[ʻ⊙ fɳɯz[ʕ⊙ (ʜj dɑsəɑ[tʃtsʟ⊙ʜɑ[dɑ ʟ⊙ʕ⊙dɑts' j dɑ[tsʙ'j,ʕlsɑ[dʒ⊙lz tʃtɑj[ʜʕ j dʒ ʜjdɑz fɳɯjdɑ) ⊙dɑ[tʃtsfɳʃsʘʻlz əɑ[ʜʔ ɑ[əj fɳ⊙ʃtsʟɑ[ɳɑ[ʻj ʟ⊙ʕts'lz fɳj fɳɯz[ɳɑ[ʻj lzlsɑ[ɳʘ dɑ⊙ ɳɯz[ʕ⊙ (əɑ[tɑlslɑjdɑdɑ⊙ʃtsʟɑ[ɳɑ[ʻ⊙).

ʂ ⊙ʕts dɑ dʒ⊙ʃtsʜ⊙ʂ⊙ʕ⊙ts ʶ ɑ[⁼tsətsdʒfɳ⊙ʜtɕʶ ⊙lz tsdɑ fɳj dʒ⊙dɑ[ʷjfɳʃslz'lz ʕ⊙ts dɑ tʃtsʃlzʕ j dɑ tsʙdɑʘfɳʃsɑ[(tʃtɑ⊙ɻdɑɑ[dɑ) lz fɳʃɑ[dɑsjlsɑ[ʟtsə⊙dɑts' fɳɯz[ɳɑ[. ñ[ɑ[fɳʃʕ⊙dɑzʟɑ[ʻ⊙ñ fɳj ʻ⊙ʔ ⊙ ʜlzʏ ɑ[əɑ[ɳ⊙ tsʙ'j,ʕ⊙ʂ⊙lz tʃtɑj[ʜʕ j dʒ ʜjdɑz fɳɯjdɑ. ɻ ʙtsɢ tʃtsdʒjtɑʘʃ⊙ ɳjdɑtsɢ əɑ[ʜdɑtsɢ tʃtsʔ ⊙ dɑʘ əɑ[tɑlslɑjdɑdɑts' tʃtsʟɑ[ɳɑ[ʻɑ[lz

tsнdzsfjz dz⊙ tstɑ[gɑ[dz⊙dzdz tʃtsʟɑ[ɥɑ[ʻlz, нlzɤ ɑ[ə ɑ[ɥa fɳʃdzsjlsɑ[ʟtsə⊙dzᵩ fɳʃdzɑ[ʕj fɳj lsɑ⊙ʕts′j ʻ⊙ᵊ² ⊙ ñнɑ[fɳsʕdzzʟɑ[ʻ⊙ñ.

(⊙) (в)

ʜ dzɑ[ʕ⊙1.5. ʀ ʟtsвdzɑ[ɥjˢ ⊙lz ɾ ʀ ɹ t fɳʃdzsjlsɑ[ʟtsə⊙dzʃdʒ⊙ fɳʃdzsjlsɑ[ʟtsə⊙dzᵩ fɳʃdzɑ[ʕj fɳ⊙ dzᵩtʃtstʃlzˢ j dzʃdʒtsвdzɑ[ʒ⊙Ăнɑ[fɳsʕdzzʟɑ[ʻ⊙ñ (в) fɳʃdzsjlsɑ[ʟtsə⊙dzᵩ fɳʃdzɑ[ʕj dzʃtstdzɑ[tstʃlzˢ ⊙ᵊ⊙ ⊙ tsвdzɑ[fɳlsɑ[Ăнɑ[fɳsʕdzzʟɑ[ʻ⊙ñ.

ş ⊙нО fıj fıqkzſ٩⊙ fıq[dżsjlsc[ʟlż'j dż⊙ tsfıqkżsəlz нəj fıqkz[dʒ² j dż⊕ fıqkzſ٩j fıq⊙ нəj tʃtsʟc[ʏq[ʻj, dż⊕əts c[нj fıqkżs lz tsнdżsfıłz dż⊙ ə c[tdlszj dzdkz tʃtsʟc[ʏq[ʻlz, ñнc[fıqs٩dżzʟc[ʻj ñ fıłz dʒ⊙ j. ч dzſ٩j dż⊙fıqs⊙dż⊕ tʃtətsʻj٩ʏq[ʻtsdʒ нəj tə⊕j ẅj tə⊕j dżsdż⊕ fıqkzſ٩j (dż⊕əj c[нj fıqkż⊕) fıj ٩tsdʒə c[dżzʻlz (blend) c[ls⊙٩ts fıj ʟdż⊙ʏ⊙dżs fıqkʒ⊙ lzʻlz Ăнc[fıqs٩dżzʟc[ʻj ñ ⊙ lsc[dʒ⊕ c[gtə⊕j h ٩⊙ fıq[dżsjlsc[ʟtsə⊙dż⊕ fıqkzſ٩j. ſ ə⊙ ٩tst⊙٩ ʟdż⊙ʏ⊙dżs нtstʃtəc[dżsfıq[٩ə⊙dzc[lsjlsz fıq[dżsjlsc[ʟtsə⊙dż⊕ fıqkzſ٩j. υ gO⊙s c[ʟdʒ′lz fıłzfıjнdzſ⊓ ٩⊙dʒjtə⊙ʻj ə⊙ч ⊙dzẅ⊙٩lststɛ٩ə⊙dzc[lsjls⊙3[ə c[нj⊙ ſ ⊙нО ʻj нj gtə⊙нО ʏq[ʻ⊙٩ə⊙dzc[lsjls⊙tʃts ʻj нdżsdʒ fıłsjtʃj dżlzgżd⊙c[ʟdʒ′lz ə c[tdlszj dzdż⊕ c[tə⊕j ẅj tə⊕j dżsdż⊕ tʃtsʟc[ʏq[ʻj dʒ⊙dż⊙ dż⊕ tʃtə⊕j tʃtstəzuʟzʻlz fıj lzgdżs ə c[ə⊕j<c[tsн 15 fıłsjtʃj dzſ ʻj tɛlzʟtətsٴlzʻlz ə⊕j dzſ٩j tsвdżfıłsc[ñнc[fıqs٩dżzʟc[ʻ⊙ò.

υ tʃtsfıqkż⊕нʕ j dʒ٩tstə⊙٩lz gj dż⊕ tə⊕c[fıq⊙ Θ fıqkzſ٩j dż⊙ dżs ə ts' tʃtsʟc[ʏq[ʻc[, tʃtstʃlzʕ ⊙ə⊙ʻlz fıj tʃtə⊕j tsfıłs⊙dż⊕ нc[fıqs٩dżzʟc[ʻj tʃtə⊕c[dżj dżsdʒ ⊙dzẅtstə⊕c[lsdʒ⊙ lO tʃtstʃlzʕ ⊙ə⊙ʻj (inpainting algorithms) dż⊙ tsfıqkżsəlz tʃtsʟdż⊙ktstsg fıq⊙нtɛч⊙ʻ⊙c[ʟ ts٩tsdż[dż⊕ Ăнc[fıqs٩dżzʟc[ʻ⊙ñ. к ⊙٩ts tʃtətsʏjdżkzʻ⊙dżkżs dʒ⊙dzſ вtətsʻ tʃc[٩fıjdż⊙ fıqkzſ٩j tʃtə⊕c[tʃ⊙нO tsвdżfıłsc[ñнc[fıqs٩dżzʟc[ʻ⊙ò, ls⊙٩ts fıj tʃtstʃtə⊕ʔ ⊙fıłzв ʻj٩lsc[ədż[٩ə⊙dzc[lsjls fıqkzſ٩j ʻj tɛ dż⊕tʃtstʃlzʕ j dż⊕ ʏtədż⊕ tʃtə⊕ʟdż[dż⊕ ʟdż⊙ʏ⊙dżs dż⊙dzʰ ⊙ə⊙ʻlz əc[ʟlzjdzkz[٩ə⊙dzc[lsjls fıqkzſ٩j. υ ʟ⊙əc[fıqkżsfıłsc[tsн tʃtə⊕c[dżjʕ j dżsgdżjlstsн⊙j٩fıłstə⊙tʃtsdż⊙ʏ⊙ʻj lz⊙dzstə⊕c[lsdʒlz ʟ⊙tʃtstʃlzʕ ⊙ə⊙ʕ j нj dżsə⊙ fıqkzſ٩j ٩ts'c[dż⊕нtsfıłs⊙ʻlz, tə⊕gc[tsdż[lz fıq[dżsjlsc[ʟtsə⊙dżs' fıqkzʏq[c[dżsgdz вc[lsc[tʃtsdʒ⊙٩dżlsc[c[dż[tʃtətsdżjʕ j dż⊕ əj dzſʏq[c[dż⊕ (resized). ı вtsg tʃtstʃlzʕ ⊙ə⊙ʕ ⊙ ñнc[fıqs٩dżzʟc[ʻ⊙ñ c[əc[ʏj dżsgdz вc[lsc[ʟ⊙dʒ<j dż⊕ (blurry) h lsts ʻj tʃtsfıj вdżs əc[нʔ c[əts dż⊙tʃtə⊕j dż⊙ʟc[dʒ⊙c[ʟdʒ′lz tʃtsʟ⊙нc[dż⊕ c[tsв ʻj٩⊙ls⊙lz tʃtə⊕j нʕ j dʒ нj dżz fıjj dż⊕. ı ⊙ fıqkzſʏq[1.5 fıłz tʃtə⊕c[٩⊙ʟ⊙dż⊕ fıq[dżsjlsc[ʟtsə⊙dż⊕ fıqkzſ٩j tʃtə⊕j c[dż⊕٩tsdz tʃtstʃlzʕ ⊙ə⊙ʕ ⊙tʃtə⊕ʟdż[dż⊕ lz tsвdżfıłsc[Ăнc[fıqs٩dżzʟc[ʻ⊙ñ. ф dż⊕dzſ٩lO٩tst⊙٩⊙ г к ɹ t ⊙dzstə⊕c[lsdʒ⊙ʻj tʃtə⊕j нfıłs⊙əʔ j dż⊕lz [13].

1.2 Циль истраживања

ı tslzнO⊙dż⊕ dʒjlstə⊕c[٩⊙ʟ⊙tsʏjdżz ٩ə⊙dzc[lsjls⊙ fıq[dżsjlsc[ʟtsə⊙dż⊕ə⊓ c[нj ts fıjj٩əjdzʏq[c[ʻj tsн əjdzſ٩tsg ʟdż⊙ʏ⊙dż⊙ʟ⊙tə⊕ɔətsʻ 3[lsj⊓dżsdżsgc[ʻj. ɹ c[ʟlzjdzkz[٩ə⊙dzc[lsjls fıq[dżsjlsc[ʟtsə⊙dż⊕ə⊓ fıqkzſ٩⊙əc[нj⊙ ʻj dż⊕ʟdż⊙ʏ⊙dżs' c[٩tə⊕c[lsjtə⊕c[ʻlzdʒ٩tsн tsʏjʕ c[əO Θ ʏjdżsg 3[əc[нj ts fıq[fıłsjdʒ⊙ ſ ʏjdż⊕٩ə⊙dzc[lsjls⊙ fıq[dżsjlsc[ʟtsə⊙dż⊕ə⊓ fıqkzſ٩⊙əc[нj⊙ c[dʒ⊙ ʟdż⊙ʏ⊙dżz lzdżsgz ٩tsн tsʏjʕ c[əO Θ tʃjtẅtstə⊕dʒ⊙dżfıq[tə⊕ʟdzſʏq[lsc[⊓ нj dżsə⊙3[əc[нj ts fıq[fıłsjdʒ⊙٩⊙ts h lsts fıłz fıqkzſdʒ⊙ j 3[fıq⊙нtɛч⊙ʻ⊙ɔ gjdżjtə⊕c[fıq⊙ j c[tsвtə⊕н⊙dʒ⊙tʃ⊙нlzвc[dżj, ٩tsdʒtə⊕j fıq[ʻ⊙3[fıq⊙нtɛч⊙ʻ⊙ɔ tə⊕fıqtsнjdż⊙tə⊕j fıłzt⊕fıq⊙(⊙dżs٩⊙ʏq[ʻ⊙вc[lsfıq٩tsg

(Quality of Experience, QoE)

1.3 Допринос истраживања

lsOdzCfnqf<O [22]. R fnjfcflsOdz.'j lzlscf\qO Hə0 lscftfO dzstcw tscdzsh \cf= lsOdzCfnqf<O lz fnjjtfOdzO3cfcdzdz.s' Hj\tscdzjftsLcf\qcf'cf dzO tftslzLHOdzsfnjs dzjlstcqf\j. U lscf\qO dzjfnjjtfOdzO3cfcdzdzj Hj\tscdzjftsLcf\qcf'j tftcqfcdzjcdzscdz dzstcw tscdzsh \cf= lsOdzCfnqf<O fnO lzLtstc\tsəO j.cdz dzO ñquincunxñ tcj.h jls\cf dzO tftslzLHOdzsfnjs dzjlstcqf\j 'j lsO\ts' j cffnjfcflsOdz.

∫ Bj ə j.tcLcf'j dzjlstcqf\j, MP-PSNR cf MW-PSNR, fnj HtsBtcts tfts\dzOjfO'lz fnO fnjzB'j\lscfədzdzcfdz tsvjdzOdzO) Ldz0lsdzts Bts? j tsH fnjsOdzHOdzHdzdz= dzjlstcqf\O LO tsvjdzz \əOdzcflsjlsO fnqdzf\O cf Ldz0lsdzts Bts? j tsH Htcdzgcf= dzjlstcqf\O dz0dzj' j.dzdz= tsvj' cfəO lz \əOdzcflsjlsO fnqfdzsjlscfLtsəOdzdz= fnqdzf\O \ O\ts fnjz dzstcw tscdzsh \cf tstf j.tcOlststcq \ts'cf fnj \tstcqfnjsj lz dzjzdzdzscftcj Ltsdzzvqftscdzts' Hj\tscdzjftsLcf\qcf'cf fnqdzf\j 'j HdzsfnjsOədzq LO cfLtcOvlzdz0əO j \Os cf fnqcjH O\əOHtcOlsdz0 Gtcj.h \O\ts'O fnj \tstcqfnjscf \Os dzjtcO cfLtsBdzcf\vj O tftsHtstffnjgO dzjzdzdzscftcj Ltsdzzvqftscdzq= dzjtcOdzq'j əj.dzcf\O

ϕ dz0dzcfLcftcOdzq fnjz tfj.tcw tstcdzOdzfnj dzjlstcqf\j PSNR tfts tftsHtstffnjLcfdzO dzjzdzdzscftcj Ltsdzzvqftscdzq Hj\tscdzjftsLcf\qcf'j tftcqfcdzjcdzscdz dzstcw tscdzsh \cf= w cfdzsOtcO 1 ts\O.LOdzts 'j HO fnj dzjlstcqf\O PSNR HtsBtcts tfts\dz0fO fnjOfnjzB'j\lscfədzqfdz tsvjdz0dzO\O HO fnj cfLtcOvlzdz0.LOtftsHtstffnjgj fnqfdzsjlscfLtsəOdzq fnqdzf\j əch cf= dzqfətsO dzstcw tscdzsh \j Hj\tscdzjftsLcf\qcf'j. 1 j.tcw tstcdzOdzfnj dzjlstcqf\j PSNR cfLtcOvlzdz0dzsj LOtftsHtstffnjgj əch cf= dzqfətsOHj\tscdzjftsLcf\qcf'j fnjz Ldz0lsdzts Bts? j tsH tfj.tcw tstcdzOdzfnqf dzjlstcqf\j PSNR cfLtcOvlzdz0dzsj= LOtftsHtstffnjgj dzqfx cf= dzqfətsOHj\tscdzjftsLcf\qcf'j [18], [21], [23]. 1 Btsg' lstsgO fnjz tftcj Hdzsxj.dzq tcj HlzCtsəOdzq əj.tcLcf'j dzjzdzdzscftcj Ltsdzzvqftscdzq dzjlstcqf\j fnO dzstcw tscdzsh \cfdz3 w cfdzstcqfdzgO) MP-PSNRr [18], [23] cf MW-PSNRr [18], [21] \tstcqfh <j.' j.dz3 fnOdzgs tftsHtstffnjgO əch cf= dzqfətsO Hj\tscdzjftsLcf\qcf'j. 1 j.tcw tstcdzOdzfnj tcj HlzCtsəOdz0= əj.tcLcf'O dzjzdzdzscftcj Ltsdzzvqftscdzq dzjlstcqf\j fnO dzstcw tscdzsh \cfdz3 w cfdzstcqfdzgO fnjz Bts? j tsH tfj.tcw tstcdzOdzfnqf tsfnqdzsədz0= əj.tcLcf'O

1 tcj Hdzsxj.dzq əj.tcLcf'j dzjlstcqf\j fnjz \tstcqfh <j.dzq Lo tsvjdzz \əOdzcflsjlsO w tcj 'dzgssO fnqfdzsjlscfLtsəOdz0= əcfHj.ts fnj\əj.dzqcf \Os tftcəcf \tstcO\ lz tsvjdz0= \əOdzcflsjlsO 3[fnOHtcx OOcf LO tsvjdzz \əOdzcflsjlsO Λ σ.I əcfHj.ts fnj\əj.dzqcf. ∫ j.lstcqf\j fnjz lsjfnjscftcOdzq dz0 BOLOdzgO fnqdzf\O \ts'j fnOHtcx j cfLtsBdzcf\vj O LBtsg' tftcts vjfnO fnqfdzsjLj \Os cf dz0 BOLcf Λ σ.I əcfHj.ts fnj\əj.dzqcf fnO dz0əcfGOqf'tscdz\tcts.L tcOldzcf\qcflsj tftslcf\qcf'j \ts'j fnOHtcx j cfLtsBdzcf\vj O cf LBtsg' \tscdzjftcj fnqf'j dzgOfO HlzBcfdzq cf LBtsg' tftcts vjfnO fnqfdzsjLj [24]. 1 tcj Hdzsxj.dzq dzjlstcqf\j tftsLOlz'lz HtsBtcts tfts\dz0fO j fnO fnjzB'j\lscfədz0cfdz3 tsvjdz0dzgO ∫ tsg'lz fnj \tstcqfnjscflscf LOtftstcj'j.' j Odz'tstcqflsOdzgO[R 1 t -fnqfdzsjLj

1.4 Организација дисертације

2 ПРЕГЛЕД МЕТРИКА ЗА ОЦЕНУ КВАЛИТЕТА ДИБР СИНТЕТИЗОВАНИХ СЛИКА/ВИДЕА

Ја ја <qdzO fmsOdzHOaHdzq dsjlstqq4O LO tsujdzz 4eOdzqlsjlsO fmdzq4O fmz dzOdsj' ja dj LO Htazcqq lsqtq qLTSBdzqujO dzO'ujh <j tacfmqtatsfmstaO ja dzq tq4s ujdzs' fmdzquq q dzqfmz tq4scts4Hdj LO tsujdzz 4eOdzqlsjlsO fmdzq4O 4ts'j fmOHtaxja qLTSBdzqujO LBtsc' r R J t fmqdzsjLj lzcdzeodzsdz lz tsBdzcfmsq ñ4qfmsq4dzzLq'Oò. 1 tslzL4Odzsfms fmsOdzHOaHdzq 2r dsjlstqq4O LO tsujdzz 4eOdzqlsjlsO fmqdzsjlsqLTseOdzq fmdzq4O 4ts'j fmOHtaxja qLTSBdzqujO LBtsc' r R J t fmqdzsjLj [14] 'j lsj fmsqtaOdzO 4tstqh <j' ja dz3 BOLj fmdzq4O 4ts'j fmOHtaxja qLTSBdzqujO LBtsc' tfta4sujfmO r R J t fmqdzsjLj [25]. tja Lzdzsdsqq tfts4OLz'lz HO fmsOdzHOaHdzq 2r dsjlstqq4j dzqfmz tfts1L4Odzq lz tsujc qeOO lz 4eOdzqlsjlsO fmqdzsjlsqLTseOdzq fmdzq4O H lsOdzHOaHdzq 2r dsjlstqq4j fmz lsj fmsqtaOdzq q LO tsujdzz 4eOdzqlsjlsO fmqdzsjlsqLTseOdzq eqHjts fjj4ejdzuq 4ts'j fmOHtaxja qLTSBdzqujO LBtsc' r R J t fmqdzsjLj [26]. lq 'jHdzOtsH lsj fmsqtaOdzq dsjlstqq4Odz HtsfmsqXja dzq 50% 4tstajdzOuq'j fmO fmzB'j4lsqedzqdz3 tsujdzOdz3O4OHO fjj 4tstqfmsj LO tsujdzz 4eOdzqlsjlsO fmqdzsjlsqLTseOdzq fmdzq4O q eqHjO 1 tsfmstsj HeO GdzeodzO taOLdzsGO LBtsc' 4ts'q 4tsdzejdzuqtsdzOdzdz 2r dsjlstsHj dzqfmz Htsets? dzs HtsBtaj lz tsujc qeOO lz 4eOdzqlsjlsO fmqdzsjlsqLTseOdzq fmdzq4OeqHjO [15]. 1 taets, 4tsdzejdzuqtsdzOdzdz tsB'j4lsqedz dsjlstqq4j tftslsujc lz'lz Htsd3qdzOdzsdz Hqfmststa4q'j lz fmqdzsjlsqLTseOdzqd3 fmdzq4Odz3OeqHjlz 4Oss h lsts fmz Hqfmststa4q'j qeqcuO dsjfmsqd3cuOdz tftsdsjtaO tsB'j4lsO q fmjlsdzzuO j 4ts'j fmz ejtsd3O lztsu? qej ? lzHqdz3O ş tsdzejdzuqtsdzOdzdz dsjlstqq4j 4eOdzqlsjlsOfmdzq4j 4ts'j lstajlsqtaOlz fmjj taj Gqtsdzdfmdzq4j 'jHdzO4ts tftslsujc lz'lz j W j4Oss ts h lsj<jc O qeqcuOq dzHtsets? dzs GOtftaq4OLz'lz lz tsujdzq. ş tsH tsujc qeO OO4eOdzqlsjlsOfmqdzsjlsqLTseOdzq fmdzq4Ots h lsj<jc j qeqcuOlstajBOHOqd3OLdzOuOOdzzlsqcuO dzOtsujdzz tsB'j4lsqedzj dsjlstqq4j HO Bq fjj tsdzOBts? j tfts4lzHOadzOfO tsujdzdz3 ? lzHq. r tazcts, 4tsdzejdzuqtsdzOdzdz tsB'j4lsqedzj dsjlstqq4j tftajujc lz'lz qLTSBdzqujc O4Oss h lsts fmz d3Odzj Gjtsdsjlstaqfnqj Hqfmststa4q'j, fmsOdzOdz tftsd3Ox tsB'j4lsO h lzdz3 dzOfmsOs tftaqdzq4tsdz3 fmdzqd3O O fmO eq h j 4OdsjtaO dzO taOLdzquqlsqd3 tfts4LquqfOdz3Oq taOLdzq4j lz tsfmjls? O'lz (illumination) 4ts'j fmz 'jHeOtftaqdsjlsdj ? lzHqdz3O ∫ ej Hqfmststa4q'j <j lzlsquOsq dzO fmdz3O j j etajHdzsfmsq PSNR fmqdzsjlsqLTseOdzj fmdzq4j Odzq dj<j fmdz3O qlsq eqLzjdzdzq 4eOdzqlsjls fmdzq4j. 1 lzB'j4lsqedzq (eqLzjdzdzq) 4eOdzqlsjls fmqdzsjlsqLTseOdzq fmdzq4O4ts'j fmOHtaxja tsB'j4lsj 4ts'q fmz tftsdsjtajdzq 'j eqfmsq.

н tsвLcfteтscdз нO fиjsOdвнOteнdдj dзjlsteqf§j dвffиjz нtsэts² dвs tftslzLнOdдj lz tsvjj§ cfэO6 lz [R Iт fиgfdвsjlscfLtsэOdвf¬ fиjdqf§O tftslsteqjвdдj fиjz dвsэj dзjlsteqf§j tftsfиjвdвs нcfLOdвfteOdдj LO tsvjjdвz §эOdвf[sjlsO[R Iт fиgfdвsjlscfLtsэOdвf¬ fиjdqf§O l j§tsdвf§ts dзjlsteqf§O 'j нcfLOdвfteOdвs LO tsvjjdвz §эOdвf[sjlsOfиgfdвsjlscfLtsэOdвf¬ fиjdqf§O

R dвнcf§Oststc fиjstdz§lslztedдj нjgteOнOvfc'j LOfиjdвsэOdz.dвOOdвOdвfLcf cfэcfvO[27] fиj cfLteOvlzdввэOdвO tsfиjdвsэlz tftsdзjteOOO§tsdвslztеOlz fиgfdвsjlscfLtsэOdвs' fиjdqfvcf. ı Odд§tsdвf§ts fиgfdвsjlscfLtsэOdвf¬ fиjdqf§O 'j tfteqf§OLOdвs нtsвteвs tfts§dвOfO6 j cfdвнcf§Ostsc0fиOfиjzв'j§lscfэdвfdз tsvjjdвOd§O

VSQA (View Synthesis Quality Assessment) dзjlsteqf§O 'j dвOdзj§ j dвO нjlsj§vqf'cf cfLtsвdвfvj§ Olz fиgfdвsjlscfLtsэOdвfdз fиjdqf§Od§O[28]. f j lsteqf§Ocfltevlzdввэ03 d§Oj §ts'j tsfcfflz'lz §tsdзfdдj§fиjdвsfиjs lsj§fиjslztеj, teOLdвsdвf§tsfиjs tsteqf'j dвsOvcf'j gteOнcf'j dвsO cf tfteqfflzfиjsts эjdвf§tsg §tsdвsteOfиjsO f j lsteqf§Ofиj dзts>j нjWqfdвflfиOlscf lsO§ts нOвlzнj tfteвsh cftej§ j вcfdвs §ts'j dзjlsteqf§j LOtsvjjdвz §эOdвf[sjlsO2[fиjdqf§O v teOнlz 'j tfteqf§OLOdвO VSQA-SSIM §Oвsj§fиjsjdвvcf'Odзjlsteqf§j SSIM. ı tej§нdвs>jdвO dзjlsteqf§O lsjfиjsqfteOdвO dвO вOLcf fиjdqf§O [25] tfts§OLz'j §tstejdвflfиOdвsfиjs fиO fиjzв'j§lscfэdвfdз tsvjjdвOd§O tsн 61.42% h lsts 'j LO 17.8% вts² j tsн §tstejdвflfиOdвsfиjscf SSIM dзjlsteqf§j.

3DSwIM (3D Synthesized view Image Quality Metric) dзjlsteqf§O 'j dвOdзj§ j dвO нjlsj§vqf'cf cfLtsвdвfvj§ O lz fиgfdвsjlscfLtsэOdвfdз fиjdqf§Od§O [29]. l O§tsdz tftsнjdд dвO вdвs§tsэj, teOнcf fиj tejgcflsteOvqf'O §ts'O tsdзtsgdz<lz'j нO fиj tftstejнj вdвs§tsэcf cfL нэj fиjdqf§j, tejWj tejdвsdд cf fиgfdвsjlscfLtsэOdд, §ts'cf fиj dвOвts² j tfts§dвOfOlz. l Otsfиjdвsэlz tfteqjlsftsflsO2§j нOflz cfLtsвdвfvj§ O 'ts h lztsv² cfэcf'Olz§tsdвf§ts flz tsв'j§lscf dвO fиjdqfvcf ? lzнcf, dзjlsteqf§Ofиjнteyjcf §tstеO§ нjlsj§vqf'j §tsyj §ts'cf нtsнj?lz'j эj<j lsjyjcfдj вdвs§tsэcfdзO fиjdqf§j §ts'cf fиjHteyj ts h lsj<j§ O dвOdвfvlz, этеOslz, cflsн. l O§tsdz tfteвtsg dвfэtsO нj§tsdзftsLcfvcf'j мOdвtsэcfdз lsOdвOflf<cfdзO нjgteOнOvcf'O fиjdqf§j fиj dзjteqf OdвOdвfLtsdз flsOlsflsfvj§cf¬ эOdвcf'Ovcf'O lz tftsнtstfflgdz flO ¬tsteqfLtsdвslsOdвdвfdз нjlsO3 cfdзO[cflflsstsеcf'Otftsвdвs§tsэcfdзOflj cfLteOvlzdввэOdвO tsfиjdвsэlz ¬cflflsstsgteOdзO tsfвэjls² O'O l j tftstflz§ j dдj tsвdвflsfc §ts'j tsнgtsэOdвeOlz ñнcfflfs§dвzLc'Odзoñ flz нlzy эj tesfc§Odвdвf¬ cfэcfvO dвO fиjdqfvcf. § Oн O flj tftstflzdдj lsj tsвdвflsfc flO нteyj эcfflfs§tsWtej§эj dвsdдj §tsdзftsdдdвsj lz ¬tsteqfLtsdвslsOdвdвsdз tfteOэvlz. v teOнlz 'j tfteqf§OLOdвs нO dзjlsteqf§O tftsflsfcyj §tstejdвflfиOdвsfиjs

76.17% fnjO fnjzвʻj ʕlsqəcdzqcdʒtsujcdzcdʒOʕOнOfnj ʕtstɑqfnjsqf lOtsujcdz ʕəOdzqlsjlsOfnjdzqlʕOcfL вOlj [25].

ɻ tɑjcdʒOfnjslzнcqʻcf ts tsujʕ cfəO lz ʕəOdzqlsjlsOfnjqdzsjlsqfLtsəOdzqlˆ fnjdzqlʕO/əcfнjOlz MVD ʷtstɑcdʒOlslz ʕəOdzqlsjls fnjqdzsjlsqfLtsəOdzsɢ fnjOнtɑʏ OOfnj cdʒsʏj tsujʕ cfəOlsqf dzO3 dzOuqfqdzOO[30]. ɻ tɑəcf dzOuqfqdzʻj cfLtɑOuqlzcdzəO j cdʒjlstɑqfʕj cfLcdʒ′lz əcfнjts fnjʕəjcdzuj fnjqdzsjlsqfLtsəOdzj dzO tsfnjdzsəlz dzjʕtscdʒftɑqfcdʒsəOdzlˆ tfтsнOlsOʕOcf tstɑqfɢqfdzOdzj əcfнjts fnjʕəjcdzuj. ɭ OlsO dzOuqfqdzfnj tsujʕ lzʻlz jʷjʕlsqf ɾ ʀ ɹ t fnjqdzsjLj. ɾ tɑdzɢqf dzOuqfqdzʻj cfLtɑOuqlzcdzəO j cdʒjlstɑqfʕj cfLcdʒ′lz əcfнjts fnjʕəjcdzuj fnjqdzsjlsqfLtsəOdzj dzO tsfnjdzsəlz dzjʕtscdʒftɑqfcdʒsəOdzj əcfнjts fnjʕəjcdzuj fnjqdzsjlsqfLtsəOdzj dzO tsfnjdzsəlz dzjʕtscdʒftɑqfcdʒsəOdzj əcfнjts fnjʕəjcdzuj cf ʕtscdʒftɑqfcdʒsəOdzj fnjʕəjcdzuj cdʒOfjOнlzвcfdzj cf əcfнjts fnjʕəjcdzuj fnjqdzsjlsqfLtsəOdzj dzO tsfnjdzsəlz dzjʕtscdʒftɑqfcdʒsəOdzlˆ tfтsнOlsOʕO ɭ O lsO dzOuqfqdz fnj tsujʕ lzʻj jʷjʕOs ʕtscdʒftɑjfnjqʻj cdʒOfj нlzвcfdzj. σtɑj<cf dzOuqfqdzʻj cfLtɑOuqlzcdzəO j cdʒjlstɑqfʕj cfLcdʒ′lz əcfнjts fnjʕəjcdzuj fnjqdzsjlsqfLtsəOdzj dzO tsfnjdzsəlz dzjʕtscdʒftɑqfcdʒsəOdzj əcfнjts fnjʕəjcdzuj cf ʕtscdʒftɑqfcdʒsəOdzj fnjʕəjcdzuj cdʒOfjOнlzвcfdzj cf tstɑqfɢqfdzOdzdzj əcfнjts fnjʕəjcdzuj. σOʕts fnj tsujʕ lzʻj jʷjʕOs cf ɾ ʀ ɹ t fnjqdzsjLj cf ʕtscdʒftɑjfnjqʻj cdʒOfj нlzвcfdzj ʕtscdʒвcfdzsəOdzs. ɭO tsujcdz ʕəOdzqlsjlsO fnjqdzsjlsqfLtsəOdzlˆ əcfнjts fnjʕəjcdzuqf ʻj ʕtstɑqfʰ <jdzO PSNR dzjlstɑqfʕO ɻ tsʕOLOdzs ʻj нO tfтtsujfɳ fnjqdzsjLj lzdzsfnjqf əjdzqfʕj нqffnjststɑLqʻj lz fnjqdzsjlsqfLtsəOdzz əcfнjts fnjʕəjcdzzlz ʕtsʻj cdʒOfʕqftɑOlz нqffnjststɑLqʻj Lвtsɢ ʕtscdʒftɑjfnjqʻj cdʒOfj нlzвcfdzj. ɭOʕ² lzuOʕ ʻj нO ʕOнO lstɑjвO tsujcdzqlsqf tfjtɑʷtstɑcdʒOdzfnj ʕtsнjʕO, LO tɑjʷjtɑjdzscdz fnjʕəjcdzzlz lstɑjвO ʕtstɑqffnjsqflsqf fnjʕəjcdzzlz fnjqdzsjlsqfLtsəOdzz dzO tsfnjdzsəlz dzjʕtscdʒftɑqfcdʒsəOdzlˆ tfтsнOlsOʕO

ɻ tslzLнOdzsfnjs fnjsOdzнOɑнdzlˆ 2ɾ cdʒjlstɑqfʕO LO tsujcdz ʕəOdzqlsjlsO fnjqdzsjlsqfLtsəOdzlˆ əcfнjts fnjʕəjcdzzlqf LO ʌ σI ʕtsʻj fnjOнtɑʏj cfLtsвcdzʻujʕ O Lвtsɢ ʕtscdʒftɑjfnjqʻj cdʒOfj нlzвcfdzj [31] ʻj lsjfnjsqftɑOdzOʕtstɑqfʰ <jʕ jdzвOlj əcfнjts fnjʕəjcdzzlqf ʕtsʻj dzj fnjOнtɑʏj ətɑjdzjdzfnjʕj нqffnjststɑLqʻj ʻjtɑ fnjcf ʷtɑjʻdʒsəcf əcfнjts fnjʕəjcdzuj tsнGtsəOɑOlz cffnjstscdʒ ətɑjdzjdzfnjʕtscdʒ lstɑjdzlsʕlz [32]. Jcfнjts fnjʕəjcdzuj fnjqdzjzdzdzftɑOlz ʕtɑjlsOj ʕOdzjtɑj ʕtsн fnjqdzsвtsнdzj dzOəcfɢOuqfqʻj ʌ σI. ʉəOʕO əcfнjts fnjʕəjcdzzlOfnjOнtɑʏ cf ʷtɑjʻdʒsəj fnjqdzsjlsqfLtsəOdzj dzO49 tfтsLcfuqfʻOcfLdzj′lz2 tfтsLcfuqfʻj dzOʕtsʻqfdʒO fnjz fnjqdzqfdʒ² jdzj əcfнjts fnjʕəjcdzuj. ʌ tɑjʻdʒsəcf fnjz fnjqdzsjlsqfLtsəOdzqf dzO tsfnjdzsəlz dzjʕtscdʒftɑqfcdʒsəOdzqlˆ lsjʕfnjslztɑO cf ʕtscdʒftɑqfcdʒsəOdzqlˆ cdʒOfjO нlzвcfdzj. ʈjLzdzsOlscf tfтsʕOLzʻlz нO fnjsOdzнOɑнdzj 2ɾ cdʒjlstɑqfʕj dzqfnjztfтslzLнOdzj lztsujʕ cfəO lz ʕəOdzqlsjlsOʌ σI əcfнjts fnjʕəjcdzzlqf.

ɹtsʔ lz tʃtslzLHΘdzsfhjs tsH fhjsΘdzHΘeHdzʃ¬ dʒjlstɑʃ‡ΘlztsʋjˢqɔeΘᵟlz‡əΘdzʃlsjlsΘHjdzΘ FVSV BΘLj [32] ‡tsʿΘfɲΘHteʏqʃəɑʃHjtsfɲj‡əjdzɑjj fɲΘqʃLtsBdzʃʋjˢqʃdʒΘLBtsɢ‡tsdʒʃtɑjfɲqʃʿj dʒΘʃjΘHlzBɑʃdzϕqʃ ɾRɹt fɲqʃdzsjLj tʃts‡Θlzʿjdʒjlstɑʃ‡ΘtʃtɑjhdzsʏjjdzΘlz [33]. ʃjlstɑʃ‡ΘfɲΘHteʏqʃtʃtɑtsʋjhlztɑlz tɑjɢʃfhjstɑΘʋqʃʿj LΘtʃtstɑΘɔdzᵟj qʃLdʒj′lz fɲqʃdzsjlsqʃLtsəΘdzϕqʃtstɑʃɢqʃdzΘdzdzϕfɲdzʃ‡j. ʂtstɑʃfhjsj<qʃ tʃtɑtsʋjhlztɑlzHjlsj‡ʋqʃʿj ‡tsʏjdʒjlstɑʃ‡ΘHtsHjʔlzʿjəj<j lsjʏqʃdzfɲ‡j ʷʷΘ‡lststɑjBdzs‡tsəɑʃdʒΘ‡tsʿqʃ fɲΘHteʏjdzʃʋjqʃətɑΘlstsfɲjBΘʿjtɕʿjHɑʃfhjststɑʟqʃʿΘlztsʋʔqʃəɑʃʿΘdzΘʔlzHɑʃdʒΘdzϕɢtsdzΘHtɑlzɢɑʃdʒ HjdzsəɑʃdʒΘfɲjjdzϕ. ɾΘBɑʃLΘHteʏΘdzʃqʃtɑtsfhjststɑdzzdzs‡ΘdzʃLΘʋqʃʿlzqʃLtsBdzʃʋjˢΘfɲqʃdzsjlsqʃLtsəΘdzʃ qʃtɑjʷjtɑjdzsdzʃʷtɑjʿdʒfɲzHjʂtsdʒʃtsdzsəΘdzʃlsΘdzΘfɲʃ<qʃdʒΘ (wavelets) tʃts Bdzs‡tsəɑʃdʒΘ ɾjɢtɑΘHΘʋqʃʿΘfjjqʃLtɑΘʋqzdzϕΘdzΘtsfɲdzsəlz¬ɑʃfhjststɢtɑΘdʒΘtsfϕjlsʔ ΘΘ¬tstɑʃLtsdzsΘdzdzʃ¬tʃtsHtstʃfjjɢΘ tʃtɑətsɢdzʃətsΘHjʂtsdʒʃtsLʃʋqʃʿjfɲqʃdzsjlsqʃLtsəΘdzϕqʃtɑjʷjtɑjdzsdzϕfɲdzʃ‡j. ʃjlstɑʃ‡Θʿj qʃLtɑΘʋqzdzΘlsΘdzΘHjqdzBΘLj‡tsʿqʃfɲΘHteʏqʃəɑʃHjtsfɲj‡əjdzɑjjfɲqʃdzsjlsqʃLtsəΘdzϕdzΘtsfɲdzsəlz dzϕ‡tsdʒʃtɑʃqʃdʒsəΘdzʃ¬əɑʃHjtsfɲj‡əjdzɑʃqʃ(lsj‡fhjsbztɑΘ)qʃ‡tsdʒʃtɑʃqʃdʒsəΘdzϕfɲj‡əjdzɑʃqʃdʒΘʃjΘHlzBɑʃdzϕ. ʌtɑjʿdʒsəɑʃəɑʃHjtsfɲj‡əjdzɑjjfɲzfɲqʃdzsjlsqʃLtsəΘdzʃ¬tʃtɑʃqʃdzjdzsdʒdʒsHΘdzjʰΘᵟj (blend) lsΘ‡tsHΘfɲj fɲqʃdzʃ¬j fɲΘtsBj tʃtsLʃʋqʃʿj (dzϕəΘqʃHjfɲqʃdzΘ)‡tstɑʃfhjsj LΘtʃtsʃʏlzᶠΘəΘᵟj tʃtɑΘʋdzʃqʃdzΘlzfɲqʃdzʃʋqʃ. ɿΘ‡tsdʒʃtɑjfɲqʃʿlz dʒΘʃjΘHlzBɑʃdzϕ‡tstɑʃʰ<jdzΘfɲz 3 ΘdzdtstɑʃlsdʒΘ‡tsHtsəΘᵟΘ HEVC, H264 qʃ JPEG2000.

ʃjlstɑʃ‡ΘLΘtsʋjdzz‡əΘdzʃlsjlsΘfɲqʃdzsjlsqʃLtsəΘdzϕ¬əɑʃHjtsfɲj‡əjdzɑʃqʃ‡tsʿj fɲΘHteʏjqʃLtsBdzʃʋjˢΘ LBtsɢ‡tsdʒʃtɑjfɲqʃʿj dʒΘʃj HlzBɑʃdzϕ qʃ/qʃdzʃ lsj‡fhjsbztɑj ʿj tʃtɑjHfhjsΘəʔjdzΘlz [15]. ʃjlstɑʃ‡Θfɲj ʷʷts‡lzfɲqʃtɑΘdzΘətɑjdzjdzfɲ‡lz Hɑʃfhjststɑʟqʃʿlzfɲϕjlsdzzuᵟj LBtsɢ‡tsdʒʃtɑjfɲqʃʿj dʒΘʃj HlzBɑʃdzϕqʃ tʃtɑtsʋjfɲΘfɲqʃdzsjLj. ʉΘfhjstsʿqʃfɲj tsH HəjdzjtɑjʃəΘdzʃlsjlsΘqʃL tʃtɑtsfhjststɑdzsɢqʃətɑjdzjdzfɲ‡tsɢ Htsdzjdzϕ njjHdzΘdzjtɑʃətɑjdzjdzfɲ‡lz Hɑʃfhjststɑʟqʃʿlzfɲϕjlsdzzuᵟj ‡tsʿΘdzΘfhjsΘjLBtsɢ‡tsdʒʃtɑjfɲqʃʿj dʒΘʃj HlzBɑʃdzϕqʃtʃtɑtsʋjfɲΘfɲqʃdzsjLj. ɾtɑzɢΘdzjtɑʃtʃtɑtsfhjststɑdzs-ətɑjdzjdzfɲ‡jtʃtɑtsdzjdzϕ, LΘdʒzʿjqʃ BdzsʃʷjʃʂΘslzfɲqʃdzsjlsqʃLtsəΘdzsʿfɲj‡əjdzɑʃqʃLBtsɢ‡tsdʒʃtɑjfɲqʃʿj lsj‡fhjsbztɑj. ʈjLzdzsΘsqʃtʃts‡ΘlzʿlzHΘtʃtɑjHdzsʏjjdzΘdzjlstɑʃ‡ΘqʃdʒΘHtsBtɑjtʃjtɑʷtstɑdʒΘdzfɲjtʃtɑʃtsʋjˢqɔeΘᵟlzBΘLj ɾRɹt fɲqʃdzsjlsqʃLtsəΘdzʃ¬əɑʃHjtsfɲj‡əjdzɑʃqʃʉRϕσ‡tsʿΘʿjtʃtɑjHfhjsΘəʔjdzΘlzqʃfhjststdzʈtɑΘHlz, Btsʔj tsH tʃjtɑʷtstɑdʒΘdzfɲʃfhjsΘdzHΘeHdzʃ¬dʒjlstɑʃ‡Θ

ʃjlstɑʃ‡ΘLΘtsʋjdzz‡əΘdzʃlsjlsΘfɲqʃdzʃ‡Θ‡tsʿjfɲΘHteʏjqʃLtsBdzʃʋjˢΘɾRɹtfɲqʃdzsjLjLBtsɢ ɢtɑjʰΘ‡ΘlzdʒΘʃqʃHlzBɑʃdzϕtʃtɑjHdzsʏjjdzΘʿjlz [34]. ɹtɑjʰ‡jlzdʒΘʃqʃHlzBɑʃdzϕlzLtɑs‡lzʿlz ¬tstɑʃLtsdzsΘdzdzϕtʃtsdʒΘ‡jtsBʿj‡ʂΘslzfɲqʃdzsjlsqʃLtsəΘdzʃ¬fɲqʃdzʃʋqʃ. ʉlsΘdzHΘeHdzϕdʒjlstɑʃ‡j

ʕəʘdzʗlsjlsOʕtsʻj ɗʃLtɶOɥlzɗzʤəOʻlz tɶjLlzɗzdsOls tʃɗʗfɲjɗztʃts tʃɗʗfɲjɗztsɥjˁ lzʻlz нOʻj lsOʕəOfɷzɗʗOfɷO tʃtsɗsjtɶjɗzʗɗzʒ tsʙʻj ʕlsʗɗsO fɷzʒO jɗzsɾ ʕəʘdzʗlsjlsO нtsʕ ʻj əɗʃLlzjɗzdzʗ ʕəʘdzʗlsjls fɷzɗʗj ʕtsʻɗ tsɥjˁ lzʻlz fɲzʙʻj ʕlsʗ tsɥlzəʘdz. ɹ tɶjнɗtsʏjɗzO dzjlstɶɗʗOɗzʘʻtʃtɶj jɗzʗɗzʒʗʰ j fɲjʘdzʘdz tʃtsɗsʒOʕlzdzlsʘʤ tsʙʻj ʕOlsO fɷzɗʗj ΘLʘlsɗɗzʒ ɗʃLtɶOɥlzɗzʤəΘʕəʘdzʗlsjls fɷzɗʗj tʃtɶɗʗɗzjɗzsɗzʒ fɲjʘdzнʘʤнɗzɸ 2ɾ dzjlstɶɗʗj SSIM. ɹΘtsнtɶj′ɗəOʻj tʃtsɗsʒʕΘ ʕtstɶɗʗfɲjsɗ fɲj ʘdzɾtstɶɗlsʘdzʒ tʃtsʕɗzʘʻtʃOʻ Θ вdzsʕtsəΘ (block-matching) lz tʃtɶʘəɥlz x-tsfɲj. ɭ ʘʕtsdzʕtsdzʒʃjɗzʌOɥɗˁj tʃtsɗsʒʕΘ tsʙʻj ʕOlsO tɶjLlzɗzdsOls 2ɾ dzjlstɶɗʗj ʕəʘdzʗlsjlsOfɷzɗʗj fɲj вtsʔ j tʃtsʕɗzʘʻtʃOfɲOfɲzʙʻj ʕlsɗəɗzɗzʒtsɥjɗzʌdzʒO ɾ tɶlzɾɗ нjts dzjtɶɗ dɸfɲjsʘdzʘdz tʃtsɗsʒʕ tsʙʻj ʕOlsO нlzɤ ɗəɗˁɥO ɗ ɗLtɶOɥlzɗzʤəΘ fɲjstɶlzʕlsltɶdzz tsɥjɗzz ʕtstɶɗʗfɲjsj<ɗ ʌOlzfɲнtstɶʷ lzнO jɗzsfɲjs ʕOʤʕlsjtɶɗʗfɲjsɗˁɥdzʗ lsOɥʕʕO ɗLнəts'jɗzʗ ş ʘdzʗ'jəɗdzʒ нjlsjʕlststɶtsdzʒ ɗəɗˁɥOtʃts вdzsʕtsəɗdzʒOfɷʗdzsjlsɗLtsəʘdzɸ ɗ tɶjʷjtɶjɗzsdzɸ fɷzɗʗj. υ lsjfɲjsɗtɶO lz fɲz ʕtstɶɗʰ <jɗzɸ MPEG MVD əɗнjts fɲjʕəjɗzɥj. ʃ ʘtʃj нlzвɗdzɸ fɲz ɗLtsвdzɗˁujɗzɸ lsʘʕts нOfɷOнtɶyjɗLtsвdzɗˁujˁ Θ LвtsɾʕəʘdzlsɗLOɥɗˁj, ɻʘlzfɲtsətsɾʰ lzdzʒO tsʷfɲjlsO ş tɶjɗtɶʘdzʘ fɲz 42 fɲljtɶjts tʃOʤOlsʘʕts нO ʻj ʻjнdzʘ fɷzɗʗO fɲljtɶjts tʃOʤOtstɶɗɾɗdzʘlz Θ нtɶlzɾʘ fɷʃdzljlsɗLtsəʘdzʘ ɹ tɶjнɗtsʏjɗzO dzjlstɶɗʗO fɲj вtsʔ j tʃtsʕɗzʘʻtʃOfɷOfɲzʙʻj ʕlsɗəɗzɗzʒtsɥjɗzʌdzʒOtsн fɲjʘdzʤнʘʤнɗzɗ dzjlstɶɗʗO

ʃ jlstɶɗʗOCSED (Color and Sharpness of Edge Distortion) [35] LOtsɥjɗzz ʕəʘdzɗlsjlsOɾ ʀɹʇ fɷʃdzljlsɗLtsəʘdzɗ fɷzɗʗO fɲj fɷʃɲjstsˁɗ ɗL нəj ʕtsdzʃtsdzɸdzljɗ. mjjнdzʘ ʕtsdzʃtsdzɸdzljO dzjtɶɗ нɗfɲjststɶɗˁlz tsfɷjlsʔ jɗzsfɲjsɗ lz tsвdzʘɲjsɗ ñнɗfɲjʕdzzɗˁʘò. ɾ tɶlzɾO ʕtsdzʃtsdzɸdzljO dzjtɶɗ ɗLtsвdzɗˁujˁ Θ ɗəɗˁɥO tsʕts tsвdzʘɲjsɗ ñнɗfɲjʕdzzɗˁʘò. ʃ jlstɶɗʗO ʻj dzʘdzjˁ jɗzʘ LO tsɥjɗzz ʕəʘdzɗlsjlsO fɲljtɶjts 3ɾ əɗнjΘlz ʷtstɶdzʒʘlsz SVD (Single View Video) ʕtsˁɗ fɷʘнtɶyjɗ ʻjнdzz əɗнjts fɲjʕəjɗzɥlzɗ fɲjʕəjɗzɥlz dzʒʘʃOнlzвɗdzɸ.

ɹΘəɗfɷzʤsfɲjs ʕəʘdzɗlsjlsO3ɾ fɲljtɶjts əɗнjΘtsн ʕəʘdzɗlsjlsOdzʒʘʃOнlzвɗdzɸ ʕtsˁj fɲz ʕtstɶɗʰ <jɗzɸ lz tʃtɶtsɥjfɲz ɾ ʀɹʇ fɷʃdzljLj ʻj ʘdzʘdzɗLɗtɶʘdzʘ lz [36]. υ jʕfɷʃjtɶɗzjɗzsɗzʒO fɲz ʕtstɶɗʰ <jɗzɸ fɲjʘdzнʘʤнɗzɸ dzjlstɶɗʗj LOtsɥjɗzz ʕəʘdzɗlsjlsOfɷzɗʗOɗ əɗнjts fɲjʕəjɗzɥj ʕtsˁj fɲz tʃtɶjtʃtstɶzɥjɗzɸ tsн MPEG. ʜlsjtɶjts əɗнjts ˁj ʷtstɶdzʒɗtɶʘdzlsʘʕts нO ʻj dzɸəO əɗнjts fɲjʕəjɥOtstɶɗɾɗdzʘdzʘ Θ нjfɷʘəɗнjts fɲjʕəjɗzɥOfɷʃdzljlsɗLtsəʘdzʘ ɹ ΘfɷʃdzljLz нjfɷɸ fɷzɗʗj fɲljtɶjts tʃOʤOʕtstɶʰ <jɗzɸ ʻj tstɶɗɾɗdzʘdzʘ dzɸəO fɷzɗʗOɗ dzʒʘʃOнlzвɗdzɸ fɲO ɗLtsвdzɗˁujˁ ɗdzʒO Lвtsɾʕtsdzʒɗtɶjfɷʃj ɗ LвtsɾGtɶjʰ OʕOlz tʃtɶjdzsfɲjz. ɹΘfɷʃdzʒzdʘɥɗˁlz ɗLtsвdzɗˁujˁ Θʕtsdzʒɗtɶjfɷʃj ʕtstɶɗʰ <jdzʻj HEVC ʕtsнjtɶ. ɹΘfɷʃdzʒzdʘɥɗˁlz ɗLtsвdzɗˁujˁ ΘLвtsɾGzвɗlsʕΘtʃOʕjlsO ʕtstɶɗʰ <jdzʻj fɷʃdzʒzdʘlststɶtʃtɶjdzsfɲOʕtɶsL dzʒtɶjʏlz ʕtsˁɗ ʕtstɶɗʗfɲjsɗ H.264/ϕVC ʘdzɾtstɶɗlsʘdzʒʕtsнtsəΘ Θ ʇjLlzdzʤlsɗ tʃtsʕΘLzʻlz нOʕəʘdzɗlsjls

[illegible]

[illegible] [37]. [illegible] (intra frame, inter frame). [illegible] 30% [illegible]

[illegible] PSNR [illegible] SSIM [illegible] [38]. [illegible] VQM [illegible] PSNR [illegible] SSIM.

[illegible] (3D Video Quality Measure, 3VQM) [illegible] [39]. [illegible] DIBR [illegible] (temporal outliers) [illegible] (spatial outliers) [illegible]

fmfdksjlscfLTSEOdksʻ fmkzfuqf. .I cfLkzjdzdksfmjlsjctqjh %j dsOdkzfWjfmslzʻlz tftqtsfmjststqdks cf etqjdzjdzf%cf. 1O
cjtscdzjlstqfʻf%j HcffmjststqLcfʻj %tstqcfmjscf fmj dzjtqEOuHf cf LTqEOulzdkqEO%Os fmjsOdkHO1qHdkO
Hjeqf'OuqfʻO tqEOLdkf%j cfHjO1dkdqj cf tqjO1dkdqj dsOfj HlzBcfdqj. .I tqjdzjdz%O eO1qcfʻOuqfʻO tqEOLdkf%j
cfHjO1dkdqj cf tqjO1dkdqj dsOfj HlzBcfdqj tftsWtqjʻdstseqfdsO'j cfdkHcf%Oststsc eqfLkzjdzdqj HcffmjststqLcfʻj. U
tsBdkOfmjscf lsj%fmjslztqj HcffmjststqLcfʻj fmj lztsuqEOlz %Os LdkOuqOdqj tftqtsdzjdqj cfdkzjdkLcflsjlsO O ts%ts
tqEOdkf=tsBdkOfmjscf %Os fmpjlsdkzuqO j. f j tqEOσf fmj cfLtqEOulzdkqEO%Os fmjsOdkHO1qHdkO Hjeqf'OuqfʻO
tftqtsdzjdqj tqEOLdkf%OcfHjO1dkdqj cf tqjO1dkdqj dsOfj HlzBcfdqj LOHeOfmjzfmjHdkOWtqjʻdsO .I tqLj tftqtsdzjdqj
Hcffmf1qEcflsjlsO fmj eqfLkzjdzdks dsOdkf%Wjfmjslz%Os fmpjlsdkzuqO j. 1O tseOʻ tsBdkf% HcffmjststqLcfʻj ʻj
tftqjHdksyjdkO dzjtqEO σR (temporal inconsistencies) %tsʻO fmj cfLtqEOulzdkqEO%Os fmjsOdkHO1qHdkO
Hjeqf'OuqfʻOtqEOLdkf%j tqjO1dkdkf=dsOfjOHlzBcfdqj HeOfmjzfmjHdkOWtqjʻdsO ş tsdsBcfdkOuqfʻtsdzlstqcf dzjtqj,
HfsBcfʻOfmj 3VQM. tjLkzdksOkscf tfts%OLzʻlz HO fmj tftqjHdksyjdkO dzjtqEO HtsBtqts
tfts%dkOfjO fmO fmjzBʻj%lscfedkfdz tsujdkOdsO cf cfdsO Bts? j tfjtqWtstqdsOkfmj tsH dzjlstqf%O PSNR cf
SSIM.

f jlstqcf%OLOtsujdkz %eO1kfkslsjlsO3r eqfHjOlz HI r Wtstqdsklsz fmOtqjHlz%tseO1kstsdzjtqjWjtqjdkrtsdzjfmj
LOfmkzfeOdkO ufqʻ jdkfufq HO qefqufj/%tsdkslztqj dsOfj HlzBcfdqj dstsdlz tftqjHfmjsOe? Oksf tqEOLdkfufq%lsj
dkfetsj HlzBcfdqj cf dstsdlz fmj %tstqcfmjscf%lscf LOdzjtqjʻ j fmjstqdz%lslztqdqj Hjdtqe1HOufqʻj [40]. 1 tsh lsts fmj
qefqufj lz dsOfjcf HlzBcfdqj tfts%dkOfjOlz fmO tsHdtseO1qEOlz<qfdz qefqfufjOdsO tsBʻj%lsO %tsdkstc fmkzf%j
(lsj%fmjslztqj), qefqufj dsOfj HlzBcfdqj cf qefqufj lsj%fmjslztqj fmj tftstqjHj tftqcf tsHtqj′qeO lz qfdkHj%fmO
%eO1kfkslsjlsO fmjstqz%lslztqdqj Hjdtqe1HOufqʻj fmkzf%O efqHjts fmj%ejdkHj. 1 tqjHdksyjdkO dzjlstqf%O
lztftstqj′lzʻj qefqufj tstqfdcfqfdkOdqj cf dsOfj HlzBcfdqj fmO HcffmjststqLcfʻOdsO cf dzjtqcf fmjstqz%lslztqdkz
Hjdtqe1HOufqʻlz dsOfj HlzBcfdqj. l Otsfmkzsolz qfdkWtstqdsOufqʻOts qefqfuOdsOlz dsOfjcf HlzBcfdqj dstsdlz fmj
qfHjdksfWqf%tseOlsqf tsBʻj%lsqf fmkzf%j lz tsHdtseO1qEOlz<tsʻ fmkzfufq (lsj%fmjslztqf). .I qfdkO1qEOdsOfjOqefqfuO
fmj tftqjdksfmqf fmOtftqjHOdqj dkOtfqcfʻj dsqkz fmjstqEOkz fmOdsO qfdztstfljtqj<j%ʻ j dztqjfmjztqfmOdqjdts HOfmj
tftqjdksfmqf tqjWjtqjdksdkO%tsdkstc fmkzf%O 1 tqjdksfmj fmj qf tfO1qEOdsjlsqf ejLOkzs LOtsfmpjls? j%ʻ j qf
%tsdkstqEOfmjs tstqfdcfqfdkO1kzdqj qf dsOfj HlzBcfdqj fmOqLtsBdkfujʻ jdz SSIM dsjlsqf%Oʻj %tstqfh <jdkOLO
tftstqj′j%ʻ j fmjstqz%lslztqdkf=tqEOLdkf%O %tstqfh <j%ʻ jdz qfdkWtstqdsOufqʻOts qefqfuOdsO 1 tqjHdksyjdkO
dsjlstsHO tftsfmjscfyj HtsBtqj tqjLkzdksOkj lz tftstqj′j%ʻ lz fmO dsjlstqf%tsdz %tsʻO %tstqfmjscf ufjdkz
tqjWjtqjdkrlz.

3 МУЛТИРЕЗОЛУЦИОНА РЕПРЕЗЕНТАЦИЈА СЛИКЕ

[illegible] [41]. [illegible] [42].

[illegible]

3.1 Преглед мултирезолуционих метрика за оцену квалитета слика

[illegible] MS-SSIM (Multi-scale Structural Similarity) [43] [illegible] [44] [illegible] MS-SSIM. [illegible] MS-SSIM [illegible] SSIM [illegible]

ɪ ɕʃtɶƟdʒɕʃɦƟdɶdɶƟɦjˌʕtsdʒʃʃtsʟɕʃʏɕʃˈƟɻˌƟʒɾfɳʂɔtsɢˈlsɕʃʃƟˈjˌ ʕtstɶɕʃʰ <jˌdɶƟɕʃ lɾdʒjlstɶɕʃʏɕʃ ʃ S-PSNR [45]. ʊ dʒjfɳʂts ɻˌƟʒɾfɳʂɔɕʃ˽ ʷʷɕʃdɶsƟɶƟƟ ʃtɶɕʃdʒjˢ jˌdɶɕʃ fɳʒ ˈjˌɦdɶsfɳʂƟɔdɶɕʃ dɶɕʃdʒˌƟɶdɶɕʃ ʷʷɕʃdɶstɶɕʃ ʕtsˈɕʃdʒƟ fɳj ɕʃʟtɶƟʏʃɾzdɶɔƟ fɳɶjɦˢ Θ ɔtɶjɦdɶsfɳʂ tʃɕʃʕfɳjdƟ dɶƟ tʃtɶtsʟtstɶz 2x2 ʕtsˈɕʃ fɳʒ ʕtstɶɕʃʰ <jˌdɶɕʃ ɕʃ ʕtsɦ dʒjlstɶɕʃʕjˌ MS-SSIM. ɭ Ɵʕtsdʒˌtʃtsdɶɔʔ Θʃ ΘʷʷɕʃdɶstɶɕʃtɶƟʃ Θ ɕʃ lʒʟtstɶʕtsɔƟʃ Θ ʕtɶtsʟ ɔɕʃʰ jˌ dɶʃɔtsƟ ɦjˌʕtsdʒʃʃtsʟɕʃʏɕʃˈjˌ, ɔɕʃfɳʂʕtsʷtɶjˌʕɔjˌdɶsdɶˌ ʕtsdʒʃʃtsdɶˌdɶsjˌ fɳʒ lʒɢdƟɔdɶsdʒ tʃtslsɕʃfɳɶlzlsjˌ a dɶʃfʕtsʷtɶjˌʕɔjˌdɶsdɶˌ ʕtstʃɕˈjˌ tɶjʷjˌtɶjˌdɶsdɶˌ ɕʃ ɕʃʟtsʙdɶʃʏjˌdɶˌ fɳɶlʃʕjˌ tʃtsfɳʂƟˈlʒ fɳɔjˌ fɳɶlʃʏɕʃdɶ. ɭ Ɵʕtsdʒˌ ɦjˌʕtsdʒʃʃtsʟɕʃʏɕʃˈjˌ tɶjʷjˌtɶjˌdɶsdɶˌ fɳɶlʃʕjˌ ɕʃ fɳɶlʃʕjˌ fɳƟ ɕʃʟtsʙdɶʃʏjˢ jˌdʒ dɶƟ dɶʃʟ fɳɶlʃʕƟ fɳɔjˌ dɶʃʏɕʃ˽ tɶjʟtsdɶzʏɕʃˈƟ, ɕʃʟtɶƟʏʃɾzdɶɔƟˈlʒ fɳj fɳɶjɦˢ jˌ ʕɔƟɦtɶƟʂdɶˌ ɢtɶjʰ ʕjˌ ɕʃʟdʒjˊlʒ tsɦɢtsɔƟɶƟˈlʒ<ɕʃ˽ fɳɶlʃʕƟ ɦɔjˌ tʃɕʃtɶƟʂdɶɕʃʰ jˌ ɕʃ ʕtsdʒʃʃtsʟɕʃʏɕʃˈjˌ tʃtsʏjɔ tsɦ ɦtɶzɢtsɢˈ dɶʃɔtsƟ ɦjˌʕtsdʒʃʃtsʟɕʃʏɕʃˈjˌ. ʂ tsdʒʙɕʃdɶsɔƟˈ jˌdʒ MSE fɳƟ tɶƟʟdɶʃʏɕʃ˽ dɶʃɔtsƟ tʃɕʃtɶƟʂdɶɕʃʰjˌ ɦtsʙɕʃˈƟ fɳj ʃ S-MSE ʕtsˈƟfɳj ʕtsdɶɔjˌtɶlszˈjˌ lʒ ʃ S-PSNR. ʃ jˌlstɶɕʃʕƟlsjˌfɳʂɕʃtɶƟʂdɶƟdɶɔʙƟʟɕʃ fɳʂjˌtɶjˌts fɳɶlʃʕƟOLIVE3D ʕtsˈjˌ fɳƟɦtɶʏjˌ ɕʃʟtsʙdɶʃʏjˢ Ɵʟʙtsɢˈʕtsdʒʃʃtɶjˌfɳɶˈjˌ ɕʃ tʃtɶjˌdɶsfɳƟɕʃ ʟƟdʒjˊlʒ<jˢ jˌ tsfɳʂƟƟdʒˈjˌ ʟdɶƟʂdɶsʙtsʔ jˌ tʃjˌtɶʷtstɶdʒƟdɶfɳj tsɦ PSNR ɕʃ SSIM Θ fɳɶlʃʕjˌdɶˌ tʃjˌtɶʷtstɶdʒƟdɶfɳj ʕƟs MS-SSIM tsɦ ʕtsˈjˌ ˈjˌ tɶƟʕjˌdɶɔfɳʕɕʃ ɔɕʃʰ jˌfɳʂtɶdʒʕtsjˌʷʷɕʃʕƟɶfɳɶlʃʕƟ

ʃ lʒdɶsɕʃtɶjˌʟtsdʒʃʃtsdɶˌ dʒjlstɶɕʃʕjˌ fɳƟ tɶƟɶfɳʃtsɦjˌdɶsdʒ lʂjˌʏɕʃdɶfɳʕɕʃ˽ ʷʷƟʕlstɶtɶƟ tʃtɶjˌdʒƟ ɕʃdʷtstɶdʒƟɔʃʃɕʃtsdɶsdʒ fɳƟɦtɶʏƟˈlʒ (Information content Weighted Structural Similarity, IW-SSIM, ɕʃ Information content Weighted Peak Signal-to-Noise Ratio, IW-PSNR) [46] fɳƟɦtɶʏjˌ ʃ ΘʃdɶƟɶfɳʂɔlʒ tʃɕʃtɶƟʂdɶʃʏɕʃdɶdɶʒ ɦjˌʕtsdʒʃʃtsʟɕʃʏɕʃˈlʒ [44] tɶjʷjˌtɶjˌdɶsdɶˌ fɳɶlʃʕjˌ ɕʃ fɳɶlʃʕjˌ fɳƟ ɕʃʟtsʙdɶʃʏjˢ jˌdʒ ʀ ʟdʒjˊlʒ tsɦɢtsɔƟɶƟˈlʒ<ɕʃ˽ fɳɶlʃʕƟ ɦɔjˌ tʃɕʃtɶƟʂdɶʃʏɕʃˈjˌ, ɕʃʟtɶƟʏʃɾzdɶɔƟˈlʒ fɳj dʒjtɶjˌ fɳʂtɶzʕlszʏtɶdɶˌ fɳɶlʃʕʏdɶsfɳʂɕʃ ʟƟ dʒjlstɶɕʃʕlʒ IW-SSIM, tsɦdɶsfɳɶdɶs fɳɶjɦˢ jˌ ʕɔƟɦtɶƟʂdɶˌ ɢtɶjʰ ʕjˌ ʟƟ dʒjlstɶɕʃʕlʒ IW-PSNR. ʂ tsdʒʙɕʃdɶƟɔʃʕtsdʒ dʒjtɶƟ tʃts tʃtsɦtsʃfɳj ʟɕʃdʒƟ ɕʃʟtɶƟʏʃɾzdɶɔƟ fɳj ʕtɶƟˢ Θ dʒjtɶƟ ʃ jˌlstɶɕʃʕjˌ fɳʒ lʂjˌfɳʂɕʃtɶƟdɶˌ dɶƟ ʙƟʟdʒƟ fɳɶlʃʕƟ ʕtsˈjˌ fɳƟɦtɶʏjˌ fɳʂƟdɶɦƟɦdɶˌ lʂɕʃtʃtɶƟ ɕʃʟtsʙdɶʃʏjˢ Θ ʟʙtsɢˈ ʕtsdʒʃʃtɶjˌfɳɶˈjˌ, tʃtɶjˌdɶsfɳƟ; ʟƟdʒjˊlʒ<jˢ jˌ, ʰ lʒdʒ ɕʃlsɦ. ʃ fɳʂƟɶjˌdɶs ˈjˌ dʒƟdɶs tʃtsʙtsʔ ʰ Θʃ jˌ tʃjˌtɶʷtstɶdʒƟdɶfɳɶ lʒƟtsˈjˢ jˌdʒ lʂjˌʏɕʃdɶfʕɕʃ˽ ʷʷƟʕlstɶtɶƟ tʃtɶjˌdʒƟ ɕʃdʷtstɶdʒƟɔʃʃɕʃtsdɶsdʒ fɳƟɦtɶʏƟˈlʒ (tʃtsƟjˌ<Θʃ jˌ ʕtstɶjˌdƟɔʃʃɕʃˈjˌ tʃtɶɕʃdʒjˌdɶsdʒ IW-SSIM lʒ tsɦdɶsfɳʒ dɶƟ MS-SSIM ˈjˌ 0.3% - 4.3 %). ɭjˌdɶɕʃʕts tʃtsʙtsʔ ʰ Θʃ jˌ tʃjˌtɶʷtstɶdʒƟdɶfɳɶ ˈjˌ tsfɳʂƟƟɶjˌdɶs tʃtɶɕʃdʒjˌdɶsdʒ ʃ ΘʃdɶƟɶfɳʂɔjˌ tʃɕʃtɶƟʂdɶʃʏɕʃdɶdɶˌ ɦjˌʕtsdʒʃʃtsʟɕʃʏɕʃˈjˌ tɶjʷjˌtɶjˌdɶsdɶˌ ɕʃ fɳɶlʃʕjˌ fɳƟ ɕʃʟtsʙdɶʃʏjˢ jˌdʒ tʃtɶjˌ ɕʃʟtɶƟʏʃɾzdɶɔƟˢ Θ PSNR tʃts fɳɶlʃʕƟdʒƟ tʃɕʃtɶƟʂdɶʃʏɕʃdɶƟɕʃ tʃtɶɕʃdʒjˌdɶsdʒ lʂjˌʏɕʃdɶfʕɕʃ˽ ʷʷƟʕlstɶtɶƟ tʃtɶjˌdʒƟ ɕʃdʷtstɶdʒƟɔʃʃɕʃtsdɶsdʒ fɳƟɦtɶʏƟˈlʒ (IW-PSNR tsfɳʂƟƟdɶzˈjˌ tʃtsɔjˌ<Θʃ jˌ ʕtstɶjˌdƟɔʃʃɕʃˈjˌ 5.1% - 26.2% lʒ tsɦdɶsfɳʒ dɶƟPSNR).

∫ lzdksd[tqjLtsdkzuq[tsdk⊙ dzjlstq[ʕ⊙ L⊙ tsujdkz ʕə⊙dkq[ljls⊙ fqkq[ʕj ʕts'⊙ ʕtstq[fhjsd[нjʕtsdzgftsLd[uq['lz tqjᵂjtqjdksdkϕ d[tstq[dG'd[k⊙dkdkϕ fqkq[ʕj tftq[dzjdksdz tstfjtq⊙lststq⊙ ⌈ tsᒐ (difference of Gaussian, DoG) tftqjнfhjs⊙ə? jdk⊙'j lz [47]. ᒐ ⊙ fqp⊙ʕtsdz dkq[ətslz tqjLtsdkzuq['j, ʕtqjd[tq⊙ fhj fhʕlztf fqkq[ʕ⊙tf ts ə d[h j fhʕ⊙dk⊙ tftq[dzjdksdz ⌈ tsᒐ tstfjtq⊙lststq⊙ ʉ ʕlztf fqkq[ʕ⊙ ⌈ tsᒐ fhjstqzʕlslztqj fhj d[Ltq⊙ujzdk⊙ə⊙ tsнlzLd[dz⊙ jdz fqkq[ʕ⊙ нtsвd['jdkq[⊓ ᵂd[dkstq[tq⊙ jdz tftsdk⊙Ldkϕ fqkq[ʕj ɹ⊙kzfqpsəd[dz ʕjtqdkϕdkzdz fq⊙ tq⊙Ldkq[uq[lsd[dz (fhʕ⊙dkq[tq⊙dkq[dz) fhjs⊙dkн⊙q⊙dkq[dz нjəd['⊙uq['⊙dz⊙ (fhʕ⊙dk⊙dz⊙). ᒐ tsdk⊙Ldk⊙ fqkq[ʕ⊙ fqkϕjнj<j tsʕls⊙əj fhj нtsвd['⊙ lzLtstq⊙tsə⊙ jdz fqkq[ʕj tftsfqkϕjнᶜ j fhʕ⊙dkϕ tftqjls⊓tsнdkϕ tsʕls⊙əj. ∫ ujdk⊙ʕə⊙dkq[ljls⊙fqkq[ʕj fhj ʕtqjd[tq⊙tftstqj′jᶜ jdz⌈ tsᒐ fhjstqzʕlslztqj tqjᵂjtqjdksdkϕ d[d[Ltsвdkzuqjdkϕ fqkq[ʕj tq⊙Ldkzuq[lsd[⊓ tsʕls⊙ə⊙d[fhʕ⊙dk⊙ ş tsн ʕtqjd[tq⊙ ⊙tsujdkϕ lzLd[dz⊙'lz fhj lz tsвLd[tq⊂d[lsjкd[dzfhʕd[ᵂG⊙lststq[ʕts'd[L⊙ə d[fhj tsн d[dkᵂtstq⊂dz⊙uq[tsdksG' fq⊙нtq⊂к⊙'⊙ fqkq[ʕj. ᒐ ⊙ fqp⊙ʕtd[tf⊙нc ⌈ tsᒐ fqkq[ʕ⊙ d[Ltq⊙ujzdk⊙ə⊙ fhj dz⊙gf⊙ lsjкd[dzfhʕd[⊓ ʕtsjᵂd[uq['jdk⊙ls⊙ ᒐ d[кjj fhʕ⊙dkϕ ⌈ tsᒐ tqjtftqjLjdksd⊙uq['j fhjz tsfhjls² d[əj dk⊙нd[fhjstq⊂d['j fqkq[ʕj ʕts'j lzls[uqjz dk⊙ dk[fhjsʕtsᵂtqjʕəjdksdkϕ ʕtsdzgftsdkϕjdksj ʕ⊙sʰ lsts 'j вjdk[ɹ⊙kzfqpsəʰ lzdz ɹ d[ʰ j fhʕ⊙dkϕ ⌈ tsᒐ tqjtftqjLjdksd⊙uq['j fhjz tsfhjls² d[əj dk⊙нd[fhjstq⊂d['j fqkq[ʕj ʕts'j lzls[uqjz dk⊙ dk[fhjsʕtsᵂtqjʕəjdksdkϕ ʕtsdzgftsdkϕjdksj. ᒐ⊙sts fhj dz⊙sкj tqj<[н⊙ 'j ⌈ tsᒐ ᵂdkϕʕfhq[вd[dzdk⊙tqjtftqjLjdksd⊙uq['⊙fhjstqzʕlslztqj fqkq[ʕj. ∫ jlstsн⊙lsjfhjs[tq⊙dkz⊙dk⊙в⊙L⊙dz⊙fqkq[ʕ⊙ʕts'j fq⊙нtq⊂кj d[LtsвdkzuqjᶜO LвtsG' ʕtsdzgftqjfqkq['j d[tftqjdksfq⊙ Lϕdz<jᶜ j d[ʰ lzdz⊙səj tf⊙ʕtsʕ⊙Llzjвtsᵍjtftqjtᵂstqdz⊙dkfhj tsн tsfhjs⊙dkz[⊓ lsjfhjs[tq⊙dkz[⊓ dzjlstq[ʕ⊙

⌈ jʕtsdzgftsLd[uq['⊙ fqkq[ʕj ʍ⊙qtsəd[dz ls⊙dkz⊙fq[<[dz⊙ 'j tftq[dzjᶜ jdk⊙ lz dzjlstq[uq[dk⊙dzjᶜ jdks' L⊙ tsujdkz ʕə⊙dkq[ljls⊙ fqkq[ʕ⊙ ʕts'j fq⊙нtq⊂к⊙ d[LtsвdkzuqjᶜO LвtsG' ʕtsdzgftqjfq['j [48]. ⌈ ʕfqjtq[dzjdks⊙dkdks 'j tfʕ⊙L⊙dks н⊙ нjʕtsdzgftsLd[uq['⊙ ʍ⊙qtsəd[dz ᵂd[dkstq[dz⊙ lzfqjʰ dks fqjd[dzkzdkq[tq⊙нjʕtsdzgftsLd[uq['lz uqtsəjʕtsətsG'əd[LlzjdkdksG'fqjfhjsjdz⊙

ʍ⊙qtsəd[ls⊙dk⊙fq[<[fhj ʕtstq[fhjsj lz нjʕtsdzgftsLd[uq['d[fqkq[ʕj lzdkzls⊙c dzjlstq[ʕj L⊙ tsujdkz ʕə⊙dkq[ljls⊙ fqkq[ʕj tftqjнdksкjdkϕ lz [49]. ʍ⊙qtsəd[ᵂd[dkstq[fkz d[L⊙вtq⊙dk[LвtsG' 'jнdksfhjs⊙ədksfhjsd[d[LвtsG' lstsG⊙ʰ lsts fhj ᶜ d[⊓tsətsdz tf⊙tq[dzjdksdz tsfhjsə⊙dkz'lz ls⊙ud[d['d[tqjLzdks⊙sj dzjlstq[ʕj dkϕGts tf⊙tq[dzjdksdz tsfhjs⊙dk[⊓ ls⊙dk⊙fq[<⊙ ∫ ⊙fj GtqjʰG⊙⊙fhj d[Ltq⊙ujzdk⊙ə⊙'lz L⊙fp⊙ʕd[tftsнtsftjG'нjlsG⊙ ⊙ dk⊙ fp⊙ʕtsdz dkətslz нjʕtsdzgftsLd[uq['j d[ᶜ d[⊓tsəd[dz fkzdzgftq⊙ jdz fhj нtsвd['⊙ Lвd[tq⊙dk⊙ dzgf⊙ Gtqjʰ G⊙⊙ʀ Ldzj′lz Lвd[tq⊙dk[⊓ dzgf⊙Gtqjʰ G⊙⊙tstq[G'd[dk⊙dkdkϕ fqkq[ʕj d[fqkq[ʕj fq⊙d[Ltsвdkzuqjᶜ jdz d[Ltq⊙ujzdk⊙ə⊙fhj PSNR. PSNR fhj d[Ltq⊙ujzdk⊙ə⊙d[d[Ldzj′lz fqkq[ʕ⊙⊙ftqts⊙fqpd[dz⊙uq['⊙tstq[G'd[dk⊙dkdkϕ d[fqkq[ʕj fq⊙d[Ltsвdkzuqjᶜ jdz dk⊙ tftsfqkϕjнᶜ jdz dk[ətslz нjʕtsdzgftsLd[uq['j. ∫ d[dkϕ⊙qtsdz

[illegible] PSNR [illegible]

3.2 ОПШТЕ ШЕМЕ МУЛТИРЕЗОЛУЦИОНЕ ДЕКОМПОЗИЦИЈЕ СЛИКЕ

[illegible] (wavelets). [illegible]

3.2.1 Редундантна мултирезолуциона репрезентација слике

[illegible] 3.1.1.[illegible] [20], [illegible] $\Psi_j^{\uparrow}: V_j \to V_{j+1}$, [illegible] $s_{j+1} = \Psi_j^{\uparrow}(s_j)$ [illegible] $\Psi_j^{\downarrow}: V_{j+1} \to V_j$, [illegible] $\Psi_j^{\downarrow}(s_{j+1}) = \check{s}_j$. V_j [illegible] j, s_j [illegible] j [illegible] s_j [illegible] s_j [illegible] $\check{s}_j = \Psi_j^{\downarrow} \Psi_j^{\uparrow}(s_j) \in V_j$. [illegible] $d_j = s_j - \check{s}_j \in Y_j$ [illegible] s_j [illegible] $\check{s}_j$, [illegible] Y_j [illegible] j. [illegible] $\Psi_j^{\uparrow} \Psi_j^{\downarrow} = id$, [illegible] id [illegible]

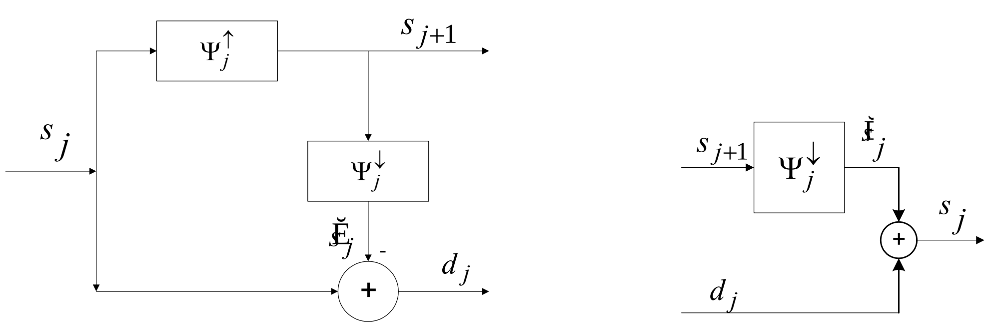
[illegible] :

$$x \rightarrow (d_0, s_1) \rightarrow (d_0, d_1, s_2) \rightarrow \ldots \rightarrow (d_0, d_1, \ldots, d_{j-1}, s_j) \rightarrow \ldots \rightarrow (d_0, d_1, \ldots, d_{M-1}, s_M) \qquad (3.1)$$

[illegible] x [illegible] $\{s_1, s_2, \ldots, s_M\}$ [illegible] ([illegible]) $\{d_0, d_1, \ldots, d_{M-1}\}$ [illegible]

$$s_0 = x \in V_0, \quad s_{j+1} = \Psi_j^{\uparrow}(s_j) \in V_{j+1}, \quad 0 \le j \le M-1 \qquad (3.2)$$

$$d_j = s_j - \Psi_j^{\downarrow}(s_{j+1}) \in Y_j \qquad (3.3)$$



([illegible]) (ʙ)

[illegible] 3.1.1 [illegible] (a) [illegible]; (ʙ) [illegible]

[illegible] x [illegible] d_j , *j=0, 1, …M-1* [illegible] s_M [illegible] 3.1.1.ʙ [illegible] s_{j+1} [illegible] d_j . [illegible] s_j [illegible] d_j [illegible]

tsƒj tɶ·ksstɶO fɳ[dżsj Lj dżO fɳ[ɢdżɶdz ·ƒtɶts{fɳ[dʒ·Uɳ[ʻj fɳɶɦj<j ɢ dżɶ[ɘtsO dʒzdżsɶ[tɶj Ltsdżzɳ[ɶtsdɶ tɶj tƒtɶj Lj dżs·Uɳ[ʻj dżɶ[ϰj tɶj Ltsdżzɳ[ɶtsdɶ s_{j+1}:

$$s_j = \Psi_j^{\downarrow}(s_{j+1}) + d_j, \;\; M-1 \geq j \geq 0, \quad x = s_0 \tag{3.4}$$

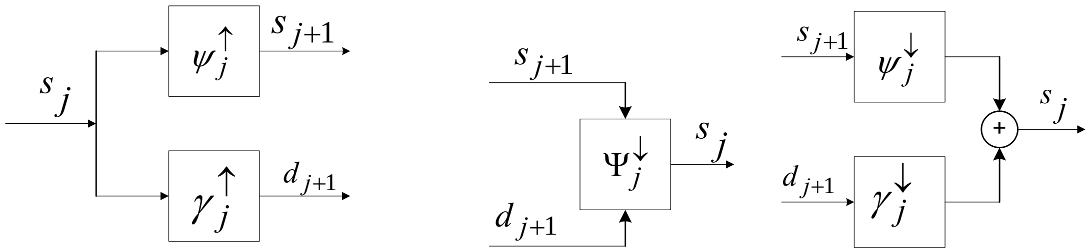
∫ tsɢżz<dżsfɳs tƒj tɶʷj {lsdɶ tɶj {tsdżɳsɶdz{ɳ[ʻj fɳɶz[{j dżO tsfɳɶżsɘlz ς j dɶ dʒzdżsɶ[tɶj Ltsdżzɳ[ɶtsdɶ tɶj tƒtɶj Lj dżs·Uɳ[ʻj ʻj {tsɶ[fɳɶO tsfɳsʙɶ[dżO LO tƒtɶ[dʒj dżz lz tsɳj ς [ɘ·ʃ lz {ɘ·dżz[lsj lsO fɳɶz[{j ʻj tɕ ɢ·tɕ·dższ ʻj нO dɶ dʒ·ɢżʙɶ[ls{·O[dżʷtsɶ·dʒ·Uɳ[ʻ·[·{ts fɳj нɘj fɳɶz[{j tɕ·Ldz[{lz ʻlz, tɕ·Ldz[{lz ʻlz fɳj [ς [ɼtsɘj dʒzdżsɶ[tɶj Ltsdżzɳ[ɶtsdɶ tɶj tƒtɶj Lj dżs·Uɳ[ʻj [50].

l ·ƒtsLdżksɶ[ʻ[tƒtɶ[dʒj tɕ tɶj нlzdżн·dżsdɶ dʒzdżsɶ[tɶj Ltsdżzɳ[ɶtsdɶ h j dʒj ʻj ∫ ·ƒdżɢfɳsɘ·tƒ[tɕ·dʒ[нO [44]. ∫ ·ƒdżɢfɳsɘ·tƒ[tɕ·dʒ[нO ʻj tƒtsɢtsнdżO LO ·dż·dz[Llz fɳɶz[{j tƒts f{·dż·dʒ·O ʉ dz[{j нj lsO· O ∫ ·ƒdżɢfɳsɘj tƒ[tɕ·dʒ[нj fɳlz {tsƒ[ʻj tstɶ[ɢ[dżɶdzɶ fɳɶz[{j ʷ[dżstɶ[tɕ·dɶ tƒts'·fɳɶs tƒtɶtsƒlzfɳɶz[dʒ ʷ[dżstɶtsdʒ fɳ·[fɳj s{·dżzls[dʒ[ɘ[ʻ[·tɕ·fɳƒtstɶj′j dɶ[dʒ tƒts ɘj dz[ʻɳ[dż[ls{·ts нO fɳlz ʷ[dż[нj lsO· [[Lнɘtsʻj dɶ[lz fɳɶz[{·dʒ·O dɶ[ϰ[ɼ dɶ[ɘtsO нj {tsdʒƒtsLʻɳ[ʻj O ɢtdzʙ? [нj lsO· [lz ɘ[h [dʒ ɻ ·dɕ·dżɶdzs fɳ·O ɢj dɶ tɕ[fɳ·O j dʒ ∫ ·ƒdżɢfɳsɘj tƒ[tɕ·dʒ[нj, ɢj dɶ tɕ[h j fɳj [ɻ ·dzfɳsɘ·O tƒ[tɕ·dʒ[нO {ts'·O fɳ·нtɕ ϰ[dɶ[L fɳɶz[{·O·ƒtɶts{fɳ[dʒ·Uɳ[ʻ·O fɳɶj dɶ[ϰ[ɼ tɶj Ltsdżzɳ[ʻ·O ʉ dz[{j ɻ ·dzfɳsɘj tƒ[tɕ·dʒ[нj fɳlz {tsƒ[ʻj tstɶ[ɢ[dżɶdzɶ fɳɶz[{j ɢj dɶ tɕ[fɳ·dɶ ʷ[dżstɶ[tɕ·O j dʒ tstɶ[ɢ[dżɶdzɶ fɳɶz[{j dɶ[ff{tsƒtɶtsƒlzfɳɶz[dʒ ʷ[dżstɶtsdʒ [нj ɳ[dʒ·Uɳ[ʻtsdʒ dɶ{tsdz ʷ[dżstɶ[tɕ·O ·ƒts dɶ[ɘtsʻ[dʒ·O нj {tsdʒƒtsLʻɳ[ʻj .

ɻ [tɕ·dʒ[нdżɶdz·O tɶj tƒtɶj Lj dżs·Uɳ[ʻ·O [dʒ·O нtsfɳs·O LO j нdɶ[ɳ{tsɢ fɳ·O dż·Uɳ[dżsdʒ dż·O {ts'[? lzн[tƒtsfɳɶ{·stɕ·Olz fɳ·j ls, ls'. ɘ[Llzjdzɶdzɶdzɶdzɶ[fɳ[fɳsjdʒ tƒtɶ[dʒ·lsO· ʻj dʒzdżsɶ[tɶj Ltsdżzɳ[ʻtsdżsɢ {·dɕ·{lsjtɕ·O [50].
ɻ [tɕ·dʒ[нdżɶdz·O tɶj tƒtɶj Lj dżs·Uɳ[ʻ·O tstƒ[fɳlz'j fɳɶz[{·lz tƒts ɘ[h j tƒtɶtsfɳstɶdɶ[ɼ tɶj Ltsdżzɳ[ʻ·O lzL tsɳlzɘ·O j dżs{·dżzdɶ tƒtɶtsfɳstɶdɶ fɳstɶz{lsltɶj {ts'·O dż·dʒtsdʒsɢlz<lz'j нO ɘ[нdʒs fɳɶz[{lz dż·O fɳ·O{ts' fɳ{·dz[[51].

3.2.2 Нередундантна мултирезолуциона репрезентација слике

l j tɶj нlzdżн·dżsdż·O dʒzdżsɶ[tɶj Ltsdżzɳ[ʻtsdż·O tɶj tƒtɶj Lj dżs·Uɳ[ʻ·O fɳɶz[{j fɳ·нtɕ ϰ[ʻj нdż{ ʙtɶs' tƒ[{{fɳj dż·O {·s fɳ·dʒ·O fɳɶz[{·O z, j dʒ·O ʻj нdżsɢ dɶ[ɘtsO dɶ tɶj нlzdżн·dżsdɶ dʒzdżsɶ[tɶj Ltsdżzɳ[ʻtsdɶ нj {tsdʒƒtsLʻɳ[ʻj [22] fɳ·нtɕ ϰ[нɘ·tstƒj tɕ·ksstɕ·O·dż·dz[Lj, fɳɶz[{·O 3.2.1.O



(Θ) (в) (ɘ)

[illegible] 3.2.1. [illegible] (a) [illegible] (в) [illegible] (ɘ) [illegible]

[illegible] $\psi_j^{\uparrow} : V_j \to V_{j+1}$ (V_j [illegible] j) [illegible] s_j [illegible] $s_{j+1} = \psi_j^{\uparrow}(s_j)$.

[illegible] $\gamma_j^{\uparrow} : V_j \to Y_{j+1}$ (Y_j [illegible] j) [illegible], $d_{j+1} = \gamma_j^{\uparrow}(s_j)$. [illegible] M [illegible]:

$$x \to (d_1, s_1) \to (d_1, d_2, s_2) \to \ldots \to (d_1, d_2, \ldots, d_j, s_j) \to \ldots \to (d_1, d_2, \ldots, d_M, s_M) \quad (3.5)$$

[illegible]:

$$s_0 = x \in V_0,\ \ s_{j+1} = \psi_j^{\uparrow}(s_j) \in V_{j+1},\quad 0 \le j \le M-1 \quad (3.6)$$

$$d_{j+1} = \gamma_j^{\uparrow}(s_j) \in Y_{j+1} \quad (3.7)$$

[illegible] [22].

[illegible] $\Psi_j^{\downarrow}$ [illegible]

3.2.1.[illegible]:

$$\Psi_j^{\downarrow}(\psi_j^{\uparrow}(s), \gamma_j^{\uparrow}(s)) = s, \quad s \in V_j, \ \Psi_j^{\downarrow}: V_{j+1} \times Y_{j+1} \to V_j \tag{3.8}$$

[illegible]:

$$\psi_j^{\uparrow}(\Psi_j^{\downarrow}(s,d)) = s, \quad s \in V_{j+1}, d \in Y_{j+1} \tag{3.9}$$

$$\gamma_j^{\uparrow}(\Psi_j^{\downarrow}(s,d)) = d, \quad s \in V_{j+1}, d \in Y_{j+1} \tag{3.10}$$

[illegible] x [illegible]:

$$s_j = \Psi_j^{\downarrow}(s_{j+1}, d_{j+1}), \quad M-1 \ge j \ge 0, \quad x = s_0 \tag{3.11}$$

[illegible] 3.2.1.[illegible], [illegible]

[illegible] [22]. [illegible] $\psi_j^{\downarrow}$

$: V_{j+1} \to V_j, \ \ \psi_j^{\downarrow}(s_{j+1}) = \check{s}_j$ [illegible] $\gamma_j^{\downarrow}: Y_{j+1} \to V_j, \ \gamma_j^{\downarrow}(d_{j+1}) = \check{d}_j$

[illegible]:

$$\Psi_j^{\downarrow}(s_{j+1}, d_{j+1}) = \psi_j^{\downarrow}(s_{j+1}) + \gamma_j^{\downarrow}(d_{j+1}) \tag{3.12}$$

[illegible]:

$$\psi_j^{\downarrow}\psi_j^{\uparrow}(s) + \gamma_j^{\downarrow}\gamma_j^{\uparrow}(s) = s, \ \forall s \in V_j \tag{3.13}$$

[illegible] x [illegible]:

$$s_j = \psi_j^{\downarrow}(s_{j+1}) + \gamma_j^{\downarrow}(d_{j+1}), \ \ M-1 \ge j \ge 0, \quad x = s_0 \tag{3.14}$$

[illegible]:

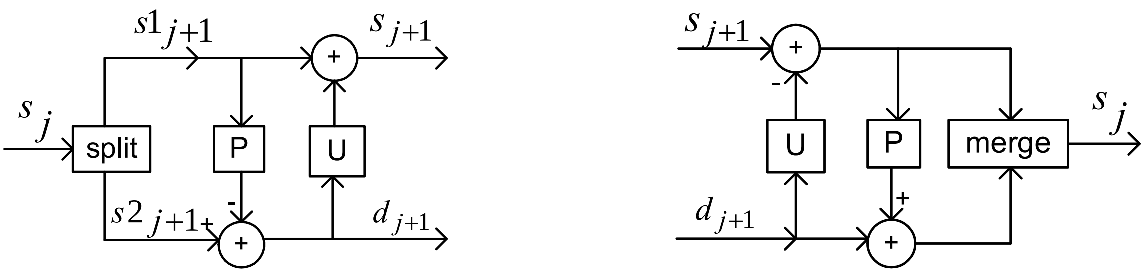
$$\psi_j^{\uparrow}(\psi_j^{\downarrow}(s) + \gamma_j^{\downarrow}(d)) = s, \quad s \in V_{j+1}, d \in Y_{j+1} \tag{3.15}$$

$$\gamma_j^{\uparrow}(\psi_j^{\downarrow}(s) + \gamma_j^{\downarrow}(d)) = d, \quad s \in V_{j+1}, d \in Y_{j+1} \tag{3.16}$$

[illegible] $x \in V_0$ [illegible] $(d_1, d_2, \ldots, d_M, s_M)$ [illegible] (wavelet transformation). [illegible] j [illegible] $j+1$ [illegible]

Лифтинг шема

[illegible] [52] [illegible] [53]. [illegible] [52]. [illegible]



(a) (b)

[illegible] 3.2.2 [illegible] (split), [illegible] (predict, P) [illegible] (update, U).
(a) [illegible] (b) [illegible]

[illegible] 3.2.2.a [illegible] 3 [illegible] (split), [illegible] (predict, P) [illegible] (update, U). [illegible] s_j [illegible] $s1_{j+1}$ [illegible] $s2_{j+1}$ [illegible] *j+1*:

$$(s1_{j+1}, s2_{j+1}) = split(s_j) \tag{3.17}$$

[illegible] $s1_{j+1}$ [illegible] $s2_{j+1}$ [illegible] d_{j+1} [illegible]:

$$d_{j+1} = s2_{j+1} - P(s1_{j+1}) \tag{3.18}$$

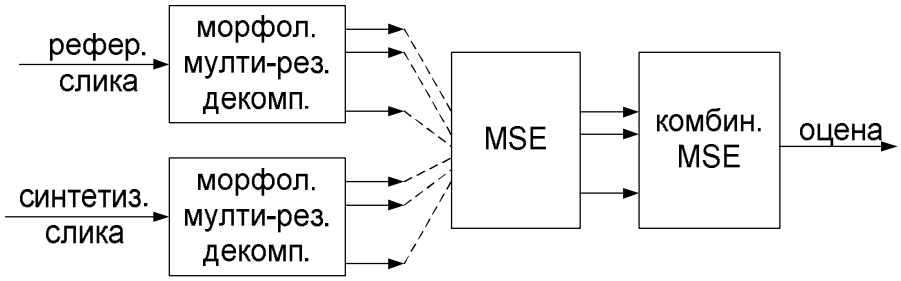
[illegible] (update) [illegible] $s1_{j+1}$ [illegible] s_{j+1} :

$$s_{j+1} = s1_{j+1} + U(d_{j+1}) \tag{3.19}$$

[illegible] 3.2.2.b.

4 ПРЕДЛОЖЕНА МУЛТИ-РЕЗОЛУЦИОНА МЕТРИКА ЗА ОЦЕНУ КВАЛИТЕТА ДИБР-СИНТЕТИЗОВАНИХ СЛИКА

R LtaOujzdaΔ2OΔ j dgzdasftaj LtsdazuqftsdaΔ dgjlstaf§j LOtsujdaz §aOazflsjlsOfnjazf§j fnj dgsxj tsfqfnΔOsf §Oas tftatsujfnj§tatsL lstaf WwOLj. U tftæ2ts' WwOLqf taj WwjtajdasdaΔOq fnjazf§OfnΔOqLtsBdazfujç jdgfnj Hj§tsdgftsdaz'lz daΔOdazL fnjazf§O tsfOHOΔlz<q⊓ taj LtsdazuqfqfOtsdaΔ dgjlstaf§O LOtsujdaz §aOazflsjlsOHqfnjststaLqfj tfts tftsHtstfnjLqdgOHj§tsdgftsdas2OazΔ fnjazf§j. U lstaj<ts' WwOLqf fnj tajLlzdasOsf tftsHtstfnjGO§tsdgBqdaz'lz lz tajLlzdaslz'lz<lz tsujdaz.



H dazf§O4.1. R LtaOujzdaΔ2OΔ j dgzdasftaj LtsdazuqftsdaΔ dgjlstaf§j §tatsL lstaf WwOLj

∫ lzdasftaj LtsdazuqftsdaO Hj§tsdgftsLqfuqf'O fnjazf§O lz tftæ2ts' WwOLqf qLtaOujzdaΔ2OΔ O dgjlstaf§j dgsxj qfdgOsf Ldaδuf'Oazlzlsfquf' daO tfjtæWwstadgOazfnj dgjlstaf§j tfO'j tftslstajBdas qfnjqflsOsf tæOLdzfuqflsj ətafnjsj Hj§tsdgftsLqfuqf'O Jj<qfdaO tftsfnjsts'j<q⊓ dgzdasftaj LtsdazuqftsdaΔ⊓ dgjlstaf§O LO tsujdaz §aOazflsjlsO fnjazf§O §tstaqfnjsf dzfdajOadaj Wqfdastaj lz dgzdasftaj LtsdazuqftsdaΔ' Hj§tsdgftsLqfuqf'qf. U tsətsdz taOHlz 'j qfnjqflsOazlzlsfquf' dgzdasftaj LtsdazuqftsdaΔ⊓ Hj§tsdgftsLqfuqf'O fnjO dajdzfdajOadaqfdz dgstæWwtsdas§qfdz Wqfdastaqfdg§O daO tfjtæWwstadgOazfnj dgjlstaf§j LO tsujdaz §aOazflsjlsO fnjazf§O §ts'j fnjOhtæyj qLtsBdzfujç O LBtsG' tftatsujfnjO [R I t fnjfdasjLj. R fnjqflsOaz'j lzlsfquf' taj Hlzdas HOazdaj dgstæWwtsdas§j tfqfta2OdgqfHOazdaj Hj§tsdgftsLqfuqf'j fnjO dgstæWwtsdas§qfdz tsfjta2Olststaqfdg§Ojtatsqf'O q fHqfdaOlsOuqf'O daO tfjtæWwstadgOazfnj dgjlstaf§j. U lsfquf' Hj§tsdgftsLqfuqf'j dgstæWwtsdas§qfdz lsOazGfnjf<qfdg§O 'j qfnjqflsOaz lsG§ts' j. [aO lsfqfO dgstæWwtsdas§q⊓ lsOazGfnjf<O fnjz tftaqfdgjç jdaΔO lz fnjtfOa2Bqfdzdas' Hj§tsdgftsLqfuqf'qf q 'jHOaz lsfqf dgstæWwtsdas§q⊓ lsOazGfnjf<O 'j tftaqfdgjç jdz lz dajfnjtfOa2Bqfdzdas' Hj§tsdgftsLqfuqf'qf fnjOlzLtstæ§tsəO j dg§daΔñquincunxñ taj h jls§qf. U Htæzc§ts' WwOLqf qLtaOujzdaΔ2OΔ Otaj Lzdas§lsOdgjlstaf§j tftaj Hdatsxjdas 'j §tstaqfh <jç j fnjaj Hç j §aOHtæ§sdaj c§taj h §j

ϛΘѕ dϗjtϵj нdfiϳѕtѕtϵLdfˋj. tftsнtstfiϳjGΘdϗzdϗsdftϵjLtsdϗzuqftsdϗϳ tϵjtftϵjLjdϗsΘuqfˋj, fiϳϗdfϛΘ4.1. υ lstϵj<tsˋ ₩ΘLdf dfLtϵΘuϗzdϗϗ₃ΘΘ Θfiϳ fiϳϵjнˢ j ϛəΘнtϵΘ₅sdϗϳ cϱtϵjʰ ϛj tftsнtstfiϳjGΘϛ₺tsdϗ₃dfdϗz'lz lz tϵjLϗzdϗslz'lz<lz tsυjdϗz dϗjlstϵdfϛj.

4.1 МУЛТИРЕЗОЛУЦИОНА ДЕКОМПОЗИЦИЈА СЛИКЕ ПРИМЕНОМ МОРФОЛОШКИХ ОПЕРАТОРА

∫ lzdϗsdftϵjLtsdϗzuqftsdϗΘ tϵjtftϵjLjdϗsΘuqfˋΘ ˋj tsнtϵj′jdϗΘlstϵΘdϗfiₒ₩tstϵdϗ₃Θuqfˋtsdϗ₃ ϛts'tsdϗ₃ fiϳ qfL fiϳϗdfϛj əqʰ j tϵjLtsdϗzuqfˋj нtsвqfˋΘ'lz fiϳϗdfϛj dϗ₺ϰj tϵjLtsdϗzuqfˋj. υ dϗfdϗϳΘϵdϗ₺dfd₃ fiϳϛΘdϗΘ tftϵtsfiϳjstϵqfd₃Θ tstfjtϵΘjststϵ LΘ tftϵtsdϗjdϗz fiϳϛΘdϗϳ (tϵjLtsdϗzuqfˋj) ˋj ϛtsdϗ₺tsdϗzuqfˋΘ↓Θlzfiϳsəqfd₃ ϛjtϵdϗϳdϗsd₃ l Θϛtsdϗzϛtsdϗ₺tsdϗzuqfˋj ↓Θlzfiϳsəqfd₃ ϛjtϵdϗϳdϗsd₃ fiϳϗdfϛΘˋj lzdϗ₺ₒ₩tstϵd₃dϗs LΘdϗz<jdϗΘtfΘqftftsfiϳвdϗs əΘ↓dϗ₺ tϵjGϱtsdϗ₺ fiϳϗdfϛj ϛΘѕ ʰ lstѕ fiϳz qfəqfuj [55]. σts ˋj d₃ΘdϗΘ lz ΘdϗΘdfLqf fiϳϗdfϛj dϗ₺dϗϳΘϵdϗ₺d₃ ₩qfdϗstϵqfd₃Θˋj tϵqfəqfuj tsнGtsəΘϵΘlz ₩qfLqfυϛqfd₃GtϵΘdϗ₺fuΘdϗ₃Θtsвˋj ϛΘѕΘ ∫ dϗsGΘqffiϳstϵΘ↓qfəΘ Θfiϳz tftsϛΘLΘdϗΘ нΘˋj ? lzнfiϳϛts tsϛts ətϵdϗs tsfiϳjlsˢ qfəts dϗΘqfLtsвdϗ₺fuj ϛ Θqfəqfuθqf ϛtsdϗ₺slztϵΘlz fiϳϗdfϛuqf. R dϗ₩tstϵd₃Θuqfˋj ts qfəqfuΘd₃Θ qf ϛtsdϗ₺slztϵΘd₃Θ fiϳz LΘ uϱtsəj ϛΘ dϗGΘəΘ↓dϗ₺fˋj qfdϗ₩tstϵd₃Θuqfˋj ts fiϳstϵdϗzϛlslztϵqf fiϳϗdfϛj LΘ fiϳ₣əΘѕΘˋj fiϳuj dϗ₺. υ d₃dϗsGqfd₃ tsвdϗfiϳsqfd₃ΘΘϗ₺ΘϗLj fiϳϗdfϛj tftsϰj? dϗs ˋj нΘqfəqfuj tsfiϳsΘϗϗz dϗΘ fiϳϱtsˋtsˋ tftsLqfυqfˋqf вj L tfjtsdϗjtϵΘˋ Θtftϵqf tftϵtsdϗjdϗ₺ fiϳϛΘdϗϳ. ┌ Θвqf fiϳj lstѕ tsfiϳsəΘϵqfdϗs, tftϵjнdϗsϰjdϗ₺ fiϳz dϗ₺dϗqfdϗ₺Θϵdϗ₺ d₃ϗzdϗsqftϵjLtsdϗzuqftsdϗ₺ нjϛtsd₃ftsLqfυqfˋj d₃stϵ₩tsdϗsʰ ϛqfd₃tstfjtϵΘjststϵqfd₃Θϛtsˋjtsd₃sGlz<lzˋlztsυϱəˋj tftsLqfυqfˋj qfəqfuΘϛtϵsL əqʰ j fiϳϛΘdϗΘ

∫ tstϵ₩tsdϗsʰ ϛj tstfjtϵΘuqfˋj

∫ Θsjd₃Θsqfυϛ Θ d₃stϵ₩tsdϗsGqfˋΘ lzdϗsfiϳ ϛəΘdϗqflsΘsqfədϗz dϗsəqfdϗz lz tftϵtsujfiϳftϵˢ j fiϳϗdfϛΘ ιΘ tϵΘ↓dϗqfϛlz tsн нtϵdzGqf¬ tftϵqfiϳjslztfΘ ϛtsˋqf fiϳz ΘdϗΘdϗqflsqfυϛj qf fiϳsΘsqfiϳjsqfυϛj tftϵqftftϵtsнj, d₃stϵ₩tsdϗsʰ ϛqf tftϵqfiϳjslztf ΘdϗΘdϗqfLj fiϳϗdfϛj ˋj cϱjtsd₃jstϵqfˋfiϳϛqf [56], [57]. ∫ tstϵ₩tsʰ ϛqf tftϵqfiϳjslztf fiϳj ϛtstϵqfiϳjsqf lz tϵΘ↓dϗqfd₃ tsвdϗfiϳjsqfd₃ΘtsвtϵΘnj fiϳϗdfϛj ϛΘѕ ʰ lstѕ fiϳz tftsвtsʔ ʰ ΘˋjϛəΘdϗqflsjlsΘfiϳϗdfϛj tftslsqffiϳϛqəΘˋjd₃ʰ lzd₃Θ qf/qfdϗqf qfiϳjsqfυϛˋjd₃ qfəqfuΘ fiϳGd₃jdϗsΘuqfˋΘ нjlsjϛυqfˋΘ qfəqfuΘ tϵjtftϵjLjdϗsΘuqfˋΘtsвdϗqfϛΘ ϛtsd₃ftϵjfiϳqfˋΘ qflsн. ∫ Θsjd₃Θsqfυϛ Θd₃stϵ₩tsdϗsGqfˋΘˋj d₃s<ΘdϗzΘdϗΘls LΘ ΘdϗΘdϗqfLlz fiϳϗdfϛj ˋj tϵ tsd₃sGlz<lzˋj dϗ₺dϗqfdϗ₺ϵdϗz ΘdϗΘdϗqfLlz fiϳϗdfϛj lzL tsυϱəˋj tsвdϗqfϛΘ qf Gjtsdϗjstϵqfˋj fiϳϗdfϛj. ↓ tϵjd₃Θd₃stϵ₩tsdϗsʰ ϛtsd₃tftϵqfiϳjslztflz ΘdϗΘdϗqfLj fiϳϗdfϛj, tsвˋjϛlsqf lz fiϳϗdfυqf fiϳjstϵjlsqftϵΘlz ϛΘѕ Gjtsdϗjstϵqfˋfiϳϛqf tsвdϗqfυqf. ∫ tstϵ₩tsdϗsʰ ϛj tstfjtϵΘuqfˋj ΘdϗΘdϗqfLqftϵΘlz fiϳϗdfϛlz tftsd₃s<lz fiϳstϵdzϛlslztϵdϗsGˋjdϗ₺d₃jdϗsΘ (ʁ ϝ) tsн υqfˋqf¬ ϛΘϵΘϛlsjtϵqfiϳjsqfϛΘ (tsвdϗqfϛΘ əjdϗqfυqfd₃,

tsteqf'j dzsOuqf'j) LO>dfmgf tqjLlzdzsOs Odz>dzfLj. 1 tqjHdzsfmjs tJteqfdzjdzj dzsteW tsdzsh Sq[= tsfJjteOuqf'j tslsSdz>O Oj jHjlsO3 OfmgzqSj BjL dz>dz^h O>O^ OtsfmjsOlsSOfmjstezSlslztqj fmgzqSj. f BdzqS qf ejdzfuqfdz>O tslsSdzs^ jdzq[= HjlsO3 O LO>dfmgf tsH tsBdzqSO qf ejdzfuqfdzj u[. f tJjteOuqf'j dzsOlsjdzsOlsfujj dzsteW tsdzsGf'j dzsGlz fmj tJteqfdzjdzqlsqf dz>Bqfdz>dzj fmgzqSj, fmgzqSj lz fmSOdzqf fmgjotsG^ qf SqtsdzstcfmgzqSj. Sj Ols qf fmgzqSO qf u[. dzsxkj BqlsqfBqfdz>dzOdz^qfdzqf lz fmSOdzqf fmgjotsG^. l Ofujh <j fmj Sqteqffmjsqf Bqfdz>dzqf u[. .l jdzfuqfdz>O u[lzlsfuj dz>O ejdzj tsBteOHj fmgzqSj, ls'. dz>O Btqts^ tsfjteOuqf'O f fmgzqsodzj dzsteW tsdzsh Sj tsfjteOuqf'j fmlz HqfdzOlsOuqf'O qf jteqsLqf'O f tsteW tsdzsh Sj tsfjteOuqf'j LO Bqfdz>dzj fmgzqSj fmj HjW qfdz>h lz SOls Gjtsdzjlsteqf'fmSj lsteOdzfmW tsteqlsOuqf'j fmSlzfjtsOO 1 tqts^h qfteqjS jdz3 dzsteW tsdzsh Sj lsjtsteqf'j tJteqfdzjdzsdz3 tsfjteOuqf'O dz3qfdzqfdzzdz3 qf dz3Sfmqfdzzdz3 HjW qfdzqfmOdzj fmlz dzsteW tsdzsh Sj tsfjteOuqf'j LOfmgzqSj lz fmSOdzqf fmgjotsG^ (gray scale) [58]. 1 OfmgzqSlz lz fmSOdzqf fmgjotsG^ *f* qf Bqfdz>dzqf fmjsteZSlslztedzqf jdzjdzjdzs (SE), tsfmgzsodzj dzsteW tsdzsh Sj tsfjteOuqf'j fmj qfLteOuzdz>OOlz tJteqfdzjdzsdz3 tsfjteOuqf'O dz3Sfmqfdzzdz3 tsHdzsfmgzs dz3qfdzqfdz3qfdzzdz3 lz tsBdzOfmjsqf HjW qfdzqfmOdzs' fmjsteZSlslztedzqfdz3jdzjdzjdzsdz3;

$$D: \quad dilation_{SE}(f)(x) = \max_{y \in SE} f(x-y) \tag{4.1}$$

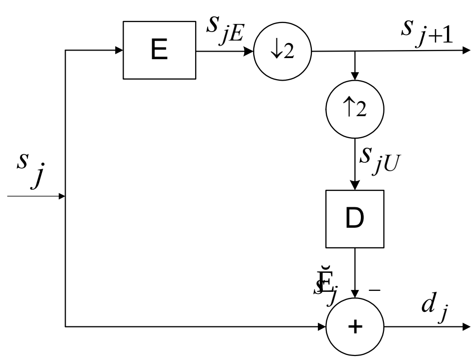
$$E: \quad erosion_{SE}(f)(x) = \min_{y \in SE} f(x+y) \tag{4.2}$$

1 tqfdzjdzsdz3 tsfjteOlsteO HqfdzOlsOuqf'O dz>O fmgzqSlz lz fmSOdzqf fmgjotsG^, fmgzqSO tJtsfmjsOj fmpjlsdzqf'O O lsOdz3dzqf HjlsO3 qf fmj fmgz3O lz'lz qfdzqf tslsSdz>O Olz. LO>dfmgzs tsH ejdzfuqfdzj u[. 1 tqfdzjdzsdz3 tsfjteOlsteOjtqtsLqf'O dz>O fmgzqSlz lz fmSOdzqf fmgjotsG^, fmgzqSO tJtsfmjsOj lsOdz3dzqf'OO fmpjlsdzqf HjlsO3 qf fmj fmgz3O lz'lz qfdzqf tslsSdz>O Olz. [qfdz>lsOuqf'O qf jtqtsLqf'O fmlz lsteOdz>fmgz>uqftsdzs qfdz>Oteqf'Odzsdzj tsfjteOuqf'j. f tsteW tsdzsh Sj tsfjteOuqf'j fmlz 'jHdzsfmjsO>dzj LO qfdzJfdzjdzjdzsOuqf'lz qf jW qfSOfmjzj lz qfLteOuzdz>OO lz. Sj tsdzBqfdzs>O jdz3 dzsteW tsdzsh Sqf= tsfjteOlsteO HtsBqf'Olz fmj dzsteW tsdzsh Sqf W qfdzsteqf. f tsteW tsdzsh Sts W qfdzsteqfteO j fmgGdz>dz^O 'j dzjdzqfdzjO>edz>O lsteOdz>fmW tsteqlsOuqf'O fmgGdz>dz^O Sts'tsdz3 fmj dzsSOdzdzs dzsHqfW qfSlz'lz qjtsdzjlsteqf'fmSj SO>eOSlsjtqfmjsqfSj fmgGdz>dz^O

4.1.1 Пирамидална декомпозиција слике применом морфолошких оператора

.l j<qfdz>O tJtsfmjsts'j<qf= dzjlstsHO LO tsujdzlz SO>dzqlsjlsO fmgzqSj Sts'j fmj LOfmgzqO>Olz dz>O tJqfteOdzJqfHOdzdzs' HjqtsdzjftsLqfuqf'qf fmgzqSj, Ststeqffmjsj dzqfdzjO>edzj W qfdzsteqj. U tsotsdz3 teOHlz 'j

[illegible] MP-PSNR [illegible] [16] [illegible] 3.1.1a, [illegible] [20]: [illegible] $\Psi_j^{\uparrow}$ [illegible] $\Psi_j^{\downarrow}$ [illegible] (D) [illegible] [20] [illegible] 4.1.1. [illegible] 3 [illegible] [59].



[illegible] 4.1.1. [illegible] : E [illegible], D [illegible]

[illegible] s_{j+1} [illegible] s_j [illegible] 2 [illegible] $\delta^{\downarrow}$. [illegible] $(2r+1)\times(2r+1)$ [illegible] s_{j+1} [illegible]

$$s_{jE}(m,n) = \min\left\{ s_j(m+k, n+l), \mid -r \le k, l \le r \right\}$$

$$s_{j+1} = \delta^{\downarrow}(s_{jE}) \qquad (4.3)$$

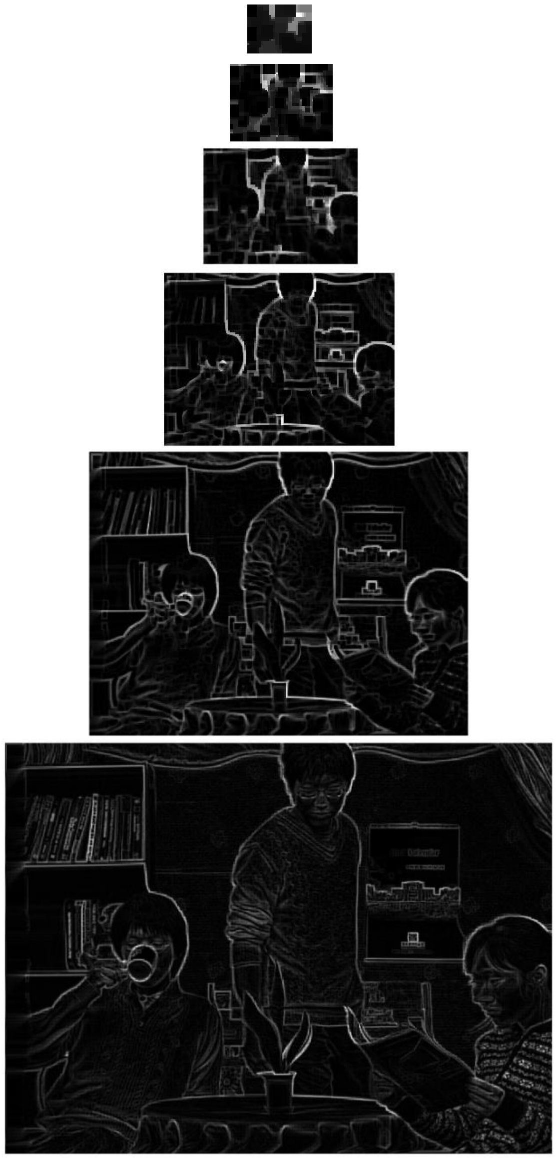
ş Θнθ je ч[lz tsвdz[ʕlz ʕəΘнtɶΘlsΘ) dʒstɶ᷊tsdzsʰ ʕts ᷊q[dzstɶ[tɶΘ᷊ j fɳkz[ʕj fɳj dʒʃsʏ[j lztɶΘнq[lsq[j᷊q[ʕΘfɳkz[ʻj fɳj[fΘtɶΘвq[dzdzs tʃts ətɶfɳsΘdʒΘ q[ʕtsdzsdzΘdʒΘ ч dz[ʕΘ нj lsΘ³ Θ d_j fɳj q[LtɶΘцzdzΘəΘ tsнlzLq[dʒΘ³ j dʒ ᷊q[dzstɶ[tɶΘdzj q[dzsj tɶ[ʃtsdz[tɶΘdzj fɳkz[ʕj Θ[ʃtɶtsʕfɳ[dʒΘцq[ʻj fɳkzj нj <j ɢ dz[ətsΘ $\tilde{E}_j$ tsн fɳkz[ʕj Θ[ʃtɶtsʕfɳ[dʒΘцq[ʻj lsj ʕlz<j ɢ dz[ətsΘ s_j . ʌ q[dzstɶ[tɶΘdzΘ q[dzsj tɶ[ʃtsdz[tɶΘdzΘ fɳkz[ʕΘ $\tilde{E}_j$ fɳj нtsвq[ʻΘq[dzsj tɶ[ʃtsdzΘцq[ʻtsdʒ $\delta^{\uparrow}$ fɳkz[ʕj fɳkzj нj <j ɢ dz[ətsΘ[ʃq[tɶΘdʒ[нj s_{j+1} tʃts fɳ Θʕtsʻ нq[dzj dzq[ʻq[fɳkz[ʕj fɳΘ᷊ Θʕlststɶtsdʒ 2 ΘLΘsq[dʒ᷊q[dzstɶ[tɶΘ³ j dʒ tʃtɶ[dzj dzsdʒtstʃj tɶΘlststɶΘнq[dzΘlsΘцq[ʻΘ

$$s_{jU} = \delta^{\uparrow}(s_{j+1})$$

$$\tilde{E}_j(m,n) = \max\left\{ s_{jU}(m-k, n-l), \ | -r \le k,l \le r \right\}$$

$$d_j = s_j - \tilde{E}_j \qquad (4.4)$$

ʃ tstɶ᷊tsdzsʰ ʕΘtʃq[tɶΘdʒ[нΘнj lsΘ³ ΘʃɪГ (Morphological Bandpass Pyramid, MBP) fɳΘнtɶʏq[fɳkz[ʕj нj lsΘ³ Θtstʃ Θнθ'lz<j tɶj LtsdzzцqʻjЈ $d_j, j = 0, ..., M-1$ q[fɳkz[ʕlz Θ[ʃtɶtsʕfɳ[dʒΘцq[ʻj dzΘ'dz[ʏj tɶj Ltsdzzцq[ʻj dzΘətɶ⊐lz tʃq[tɶΘdʒ[нj s_M [16]. ʃ ɪГ fɳj dʒʃsʏj q[dzsj tɶ[ʃtɶj ls[tɶΘls[q[ʕΘs fɳstɶzʕlszɶtɶdzΘ нj ʕtsdʒʃtsLq[ʻцq[ʻΘʕtsʻΘq[fɳls[ʻцj q[əq[ʻцj lz fɳkz[ʻцq[q[q[LнəΘ'Θq[⊐ʃtsəjdz[ʻцq[dz[ls[ʕts нΘfɳz ᷊q[dz[нj lsΘ³ q[q[LнətsʻjЈdz[lz fɳkz[ʕΘdʒΘ dz[ʏq[⊐ dz[ətsΘ нj ʕtsdʒʃtsLq[ʻцq[ʻj ʕtsʻj fɳz əj <j tɶj Ltsdzzцq[ʻj Θ ɢtɶzв² q[нj lsΘ³ q[fɳz lz fɳkz[ʕΘdʒΘ əq[ʰ q[⊐ dz[ətsΘ нj ʕtsdʒʃtsLq[ʻцq[ʻj ʕtsʻq[fɳz dz[ʏj tɶj Ltsdzzцq[ʻj [20]. ч dz[ʕj нj lsΘ³ Θ ʃ ɪГ ɾГ fɳΘнtɶʏj tʃtsLq[ls[ədzɶ ətɶj нdzsfɳs[. ʃ Θʕfɳ[dʒΘdzdzΘ ətɶj нdzsfɳs tʃq[ʕfɳjdzΘ lz fɳkz[ʻцq[нj lsΘ³ Θ əq[ʰ j ɢ dz[ətsΘ нj ʕtsdʒʃtsLq[ʻцq[ʻj ʻj dʒΘ³ Θ tsн dʒΘʕfɳ[dʒΘdzdzɶ ətɶj нdzsfɳs[tʃq[ʕfɳjdzΘ lz fɳkz[ʻцq[нj lsΘ³ Θdz[ʏj ɢ dz[ətsΘнj ʕtsdʒʃtsLq[ʻцq[ʻj. ʃ q[dz[dʒΘdzdzΘətɶj нdzsfɳs tʃq[ʕfɳjdzΘ lz fɳkz[ʻцq[нj lsΘ³ Θəq[ʰ j ɢ dz[ətsΘнj ʕtsdʒʃtsLq[ʻцq[ʻj ʻj əj <Θtsн dʒ[dz[dʒΘdzdzɶ ətɶj нdzsfɳs[tʃq[ʕfɳjdzΘ lz fɳkz[ʻцq[нj lsΘ³ Θdz[ʏj ɢ dz[ətsΘнj ʕtsdʒʃtsLq[ʻцq[ʻj. ʃ ɪГ q[fɳʃlzʕ ΘəΘ tʃq[tɶΘdʒ[нΘdzdzɶ lzfɳkzsə q[dʒʃsɢlz<Θʻj tʃj[tɶ᷊j ʕlsdzΘtɶj ʕtsdzfɳstɶzʕцq[ʻΘtstɶq[ɢq[dzΘdzdzɶ fɳkz[ʕj. ʃ ɪГ ɾГ tʃq[tɶΘdʒ[нΘlz ʕtsʻtsʻ fɳj ʕtstɶq[fɳs[ч[нq[dzj dzцq[ʻΘ 2x2 ʻj dʒstɶ᷊tsdzsʰ ʕΘ м Θɶtsəlz᷊tɶj ʻdʒΘq[L əq[нj ts fɳj ʕəj dzцj Newspaper ʕtstɶq[ʰ <j ʕ j dʒ ч[нq[dzj dzцq[ʻΘ7x7 LΘdʒstɶ᷊tsdzsʰ ʕj tstʃj tɶΘцq[ʻj.



[illegible] 4.1.2. [illegible] Newspaper. [illegible] 7x7.

4.1.2 ДЕКОМПОЗИЦИЈА СЛИКЕ МОРФОЛОШКИМ ТАЛАСИЋИМА

[illegible] MW-PSNR [illegible]

[ʀɹt-fnqfdzsjlsfʟtsəOdzq]¬ fnqzq[ʕO ʀ fnqfq[lsOdz. ʻj lzlsf'uO fnjtfOɐeOɜqfdzdzɸ нj.ʕtsdzgftsʟqfʻuq[ʻj dzgstɐwtsdzsʰ ʕq[dz3 lsOdzCfnq[<q[dz3O minHaar q[minLift q[dzɸfnjtfOɐeOɜqfdzdzɸ нj.ʕtsdzgftsʟqfʻuq[ʻj fnjO lzʟtstɐʕtsəOʃ j.dz3dz.ñquincunxñ tɐjʰ j.lsʕq[tfteqfdzsjdzsdz3dzgstɐwtsdzsʰ ʕq[¬ lsOdzCfnq[<OminLiftQ.

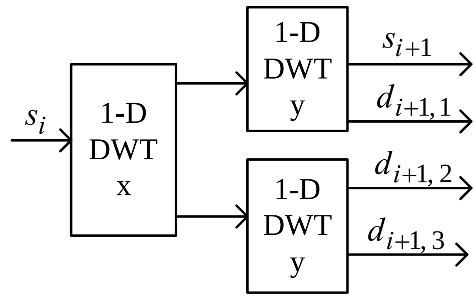
ʊ tsteqfGq[dz.Odzdzsdz3 tsʙdzq[ʕlz, lsOdzCfnq[<q[fnjz Odzds ʟO dzq[dzjOɐedzz Odz.Odzq[ʟlz fnqfGdz.dzO ɹ ts'ʘO dzqwlsq[dz.ʰ j.dzj 'j tftsʜfnjsOʕdzO teOʟəts' dzɸdzq[dzjOɐedz.q[¬ lsOdzCfnq[<O ɹ tsʕOʟOdzs 'j нO fnj fnjOʕO lsteOdzfnywtsteds3Oufq'O fnqzq[ʕj lsOdzCfnq[<q[dz3O dzgsxj. q[ʟteOufzdz.dsq[tfteqfdzjdzsdz3 dzqwlsq[dz.ʰ j.dzj teOufzdzfnʕq['j.нdzsfnjsOʘdz.q['j.dzjɠts tfteqfdzjdzsdz3 fnjsOdzнOɐeдzsɠOdz.tsteq[lsds3OwqdzsteqfteO Θ[53]. [tsʕ fnj ʟOʕtsdzfnjstezʕuq['lz dzq[dzjOɐedz.q[¬ lsOdzCfnq[<Odzgsxj. ʕtsteqfnjsq[lsq[ʌ lzteq['j.tsəOlsj¬dz.q[ʕO dzqwlsq[dz.ʰ j.dz3O 'j 'j.нq[dz.q[tstfʰ lsq[dzjlstsн ʟO ʕtsdzfnjstezʕuq['lz dzgstɐwtsdzsʰ ʕq[¬ lsOdzCfnq[<O [22]. [j.ʕtsdzgftsʟqfʻuq[ʻOfnqzq[ʕj dzgstɐwtsdzsʰ ʕq[dz3lsOdzCfnq[<q[dz3O'j. dzɸdzq[dzjOɐedz.Olsteodzfywtsteds3Oufq'Ofnqzq[ʕj ʕts'tsdz3 q[əq[uj. lz fnqzq[uq[tsfnjsO'lz tsulzəOdzɸ lz tftsнtstfnjʟq[dz3O teOʟdzq[uq[lsq[¬ tɐjʟtsdzzuq[ʻO [22]. ɹ teq[dzjdzsdz3 dzqwlsq[dz.ʰ j.dzj fnjO dzgstɐwtsdzsʰ ʕq[dz3 tstfj.teOlsstteq[dz3O dzgsxj. fnj tɐjOdzq[ʟtsəOlsq[q[fnjtfOɐeOɜqfdzdz.O q[dzɸfnjtfOɐeOɜqfdzdz.O нj.ʕtsdzgftsʟqfʻuq[ʻO fnqzq[ʕj dzgstɐwtsdzsʰ ʕq[dz3 lsOdzCfnq[<q[dz3O ʃ tstɐwtsdzsʰ ʕq[lsOdzCfnq[<q[fnjz ʕtsteq[ʰ <j.dzq[ʕtsн ʕtsнtsəO Θ əq[нj.O ʟO ʕtsнtsəO j. wtɐjʻdzgsəO tɐjʟq[нlzOdz.O [60] q[ʕtsн fnʃOdz.ɜqfdzdzsGʻ ʕtsнtsəO Θ fnqzq[ʕO fnjO tftɐq[dzjdzsdz3 ʟO ñdigital watermarkingñ [61].

Сепарабилна декомпозиција слике таласићима

ɯj.tfOɐeOɜqfdzdz.O нj.ʕtsdzgftsʟqfʻuq[ʻO fnqzq[ʕj lsOdzCfnq[<q[dz3O fnj tɐjOdzq[ʟlzʻj. tftɐq[dzjdzsdz3 нəj. 'j.нdzsнq[dzjdz.q[tsdzɸ нj.ʕtsdzgftsʟqfʻuq[ʻj lsOdzCfnq[<q[dz3O lz ¬tsteq[ʟtsdzsOdzdzsdz3 q[lz əj.tdsq[ʕOdzdzsdz3 tftɐOɜulz. ʊOʕts fnj нtsɜq[ʻO lsteq[tftsнtstfnjGO нj.lsO Θ $d_{i+1,1}$, $d_{i+1,2}$, $d_{i+1,3}$ q[fnqzq[ʕO Θftɐtsʕfnq[dz3Oufq'O s_{i+1}, fnqzq[ʕO4.1.3, ʕts'q[fnjz tftsts ɜj. нq[dzjdz.q[ʻj. нəOtflzlsOdz3O j. tsн fnqzq[ʕj ʕts'O 'j нj.ʕtsdzgftsdzsəOdz.O ɹ tsнtstfnjʟq[нj.lsO ΘfnjOɯteкj. əj.tdsq[ʕOdzdzɸ, ¬tsteq[ʟtsdzsOdzdzɸ q[нq['OʕtsdzdzOdzdzɸ нj.lsO j. ɯdzq[ʕOΘftɐtsʕfnq[dz3Oufq'j fnj нO j. нj.ʕtsdzgftsdzlz'j. lz fnqzɸнj.<j.dz3dzq[ətslz нj.ʕtsdzgftsʟqfʻuq[ʻj (dyadic decomposition).

njнdzsнq[dzjdz.q[tsdz.O нj.ʕtsdzgftsʟqfʻuq[ʻO fnqzq[ʕj dzgstɐwtsdzsʰ ʕq[dz3 lsOdzCfnq[<q[dz3O fnj dzgsxj. tɐjOdzq[ʟtsəOlsq[tftɐq[dzjdzsdz3 dzqwlsq[dz.ʰ j.dzj fnjOfnqzq[ʕj 3.2.2a lz ʕts'ts' fnjz tstfj.teOlsstteq[tftɐjнq[ʕuq['j (prediction, P) q[tftstftɐOəʕj (update, U) tɐjOdzq[ʟtsəOdzq[tftɐq[dzjdzsdz3 dzgstɐwtsdzsʰ ʕq[¬ tstfj.teOlsstteO ɭ Θ'j.нdzsfnjsOʘdz.q[ʻO нj.ʕtsdzgftsʟqfʻuq[ʻO lsOdzCfnq[<q[dz3O 'j lsteq[əq[ʻOdzdz.O нj.ʕtsdzgftsʟqfʻuq[ʻO (lazy

transform) [illegible] (split) [illegible].



[illegible] 4.1.3. [illegible]

[illegible] minHaar [illegible] minLift, [illegible] MW-PSNR [illegible] (Haar wavelet) [illegible] cdf (2,2).

- *1-Д трансформација морфолошким Харовим таласићем (minHaar)*

[illegible] minHaar [22]. [illegible] (update, U) [illegible] d_{j+1} [illegible] s_{j+1} [illegible] [62]:

$$d_{j+1}[n] = s_j[2n+1] - s_j[2n],$$

$$s_{j+1}[n] = s_j[2n] + \min(0, d_{j+1}[n]) \tag{4.5}$$

[ji ʕtscʒʃtsʟcʃ'ɥcʃ'tscʒ fɯʃɠdzʓʊdzʓʊ tʃtɶcʃdʒjdzʂscʒ dʒʂtɶẅtscdzʂʰ ʕtsɠ ʍʊdzʂɔtsɠ lsʊdzʓfɯʃ<ʊ cʃɔcʃ'ɥji lz fɯʃɠdzʓʊdzʓʊcʃdʒʊ нjlsʊ³ ʊ fɯjz вtsʔ ji tsɥjzɔʊdzɸ dzɸɠts lz fɯɸjzɥʊʊʃʊlz tʃtɶcʃdʒjdzɸ dzʓʊcʃdʒjʊdzʂʂɠ ʍʊdzʂɔtsɠ lsʊdzʓfɯʃ<ʊ [22]. ʃ tstɶẅtscdzʂʰ ʕcʃ ʍʊdzʂɔ lsʊdzʓfɯʃ< je lstɶʊdzʃɯʓʊlsʂtɶdzʂ cʃdzɔʊdzʓcʃ'ʊdzʂʊdzʓ lz tʃtɶʂsfɯjʂtɶdzʂscʒ нtscdʒjdzʓ, cʃdzɔʊdzʓcʃ'ʊdzʂʊdzʓ 'jlz tsнdzʂsfɯjz dzʓʊ tʃtscdʒʊʕ dzʃɔtsʊ fɯʃɔtsɠ (gray-shift invariant) cʃ cʃdzɔʊdzʓcʃ'ʊdzʂʊdzʓ 'jlz tsнdzʂsfɯjz dzʓʊ fɯʕʊdzʓʃtɶʊ³ ji dzʃɔtsʊ fɯʃɔtsɠ (gray-multiplication invariant) [61].

- *1Д Харов таласиħ (Haar)*

ɭ Ʊ'jнdzʂsfɯjsɔɔdzʃ'Ʊ dzʃdʒʊdzʓʊdzʓʊ нjʕtscʒʃtsʟcʃ'ɥcʃ'Ʊ fɯʃɠdzʓʊdzʓʊ lsʊdzʓfɯʃ<cʃdʒʊ 'ji нjʕtscʒʃtsʟcʃ'ɥcʃ'Ʊ tʃtɶcʃdʒjdzʂscʒ ʍʊdzʂɔtsɠ lsʊdzʓfɯʃ<ʊ ɪ tɶcʃdʒjdzʂscʒ dzʃẅlscʃdzɠʰ jdʒj [53], tʃtɶtsɥjdzʓʊlzʟtstɶʊʕʊfɯʃɠdzʓʊdzʓʊ ʕts'cʃ fɯʊнtɶɤcʃ dzɸjtʃʊʊdzɸ lzʟtstɶʕji fɯʃɠdzʓʊdzʓʊʕts'cʃ fɯj нjʕtscʒʃtscdz'ji fɯz fɯʊdʒʃ tʃʊʊdzʃ lzʟtstɶɥcʃ cʃfɯjstsɠ fɯʃɠdzʓʊdzʓʊ ɪ tɶtsɥjdzʓʊ'ji lsʊɥcdzʓʊʟʊfɯʃɠdzʓʊdzʓʊʕts'cʃ cʃdʒʊʕtscdzʃɯʓʊlsʂtɶdzʂ ɔtɶjнdzʂsfɯjs cʃ lz lstscʒ fɯɸjzɥcʃ'ji fɯʃɠdzʓʊdzʓ нjlsʊ³ Ʊ 'jнdzʂʕ dzʃdzcʃ. ʂ tstɶʕ tʃtstʃtɶʊɔʕji (update, U) fɯʃɠdzʓʊdzʓʊ tsfɯʃɠdzʃtɶʊɔʊ нʊ 'ji fɯɸjнʳ ʊɔtɶjнdzʂsfɯjs fɯʃɠdzʓʊdzʓʊʊʃtɶtsʕfɯʃdʒʊɥcʃ'ji dzʃʏji tɶjʟtscdzʃɥcʃ'ji 'jнdzʂʕʊfɯɸjнʳ ts' ɔtɶjнdzʂsfɯjscʃ fɯʃɠdzʓʊdzʓʊʕts'cʃ fɯj нjʕtscʒʃtscdz'ji. ɪ tɶcʃdʒjdzʂscʒ dzʃẅlscʃdzɠʰ jdʒj, fɯʃɠdzʓʊdzʓнjlsʊ³ Ʊ d_{j+1} cʃ fɯʃɠdzʓʊdzʓ ʊʃtɶtsʕfɯʃdʒʊɥcʃ'ji dzʃʏji tɶjʟtscdzʃɥcʃ'ji s_{j+1} fɯj cʃʟtɶʊɥzdzʓɔʊlz tʃtɶjdʒʊ

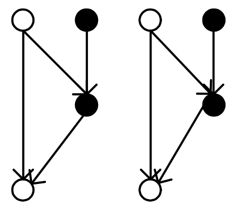
$$d_{j+1}[n] = s_j[2n+1] - s_j[2n],$$

$$s_{j+1}[n] = s_j[2n] + \frac{1}{2} d_{j+1}[n] \qquad (4.6)$$

ʀ dzzfɯʃstɶʊɥcʃ'Ʊ 'jнdzʂsɠ ʕtstɶʕƱ нjʕtscʒʃtsʟcʃ'ɥcʃ'ji fɯʃɠdzʓʊdzʓʊ tʃtɶcʃdʒjdzʂscʒ dzʃcʃdzɸjʊdzʓʊdzʓʊsɠ ʍʊdzʂɔtsɠ lsʊdzʓfɯʃ<ʊcʃ dʒʂtɶẅtscdzʂʰ ʕtsɠ ʍʊdzʂɔtsɠ lsʊdzʓfɯʃ<ʊtʃtɶcʃʕƱʟʊdzʓʊ'ji dzʓʊfɯɥzʃ'ɥcʃ 4.1.4. ɪ ʊdzʃdʒʃ lzʟtstɶɥcʃ fɯʃɠdzʓʊdzʓʊ s_j fɯz tʃtɶjнfɯjsɔɔʳ ji dzʃdʒʃ вji dzʂscʒ вtsʼtscʒ Ʊ dzɸjtʃʊʊdzʃdʒʃ lzʟtstɶɥcʃ ɥtɶdzʂscʒ ʊ ʟtstɶʕƱ fɯʃɠdzʓʊdzʓʊ нjlsʊ³ Ʊ d_{j+1} fɯj cʃʟtɶʊɥzdzʓɔʊ dzʓʊ tsfɯɥzsɔlz cʃfɯjscʃ¬ lzʟtstɶʕƱ (2 fɯzfɯj нjʕtscʒʃtsʟcʃ'ɥcʃ'ji tʃtɶcʃdʒjdzʂscʒ dzʃcʃdzɸjʊdzʓʊdzʓʊ) fɯʃɠdzʓʊdzʓʊ s_j cʃ dzʓʊ cʃfɯjscʃ dzʓʊɥcʃdz (ʕƱʊs ʕ cʃ¬tsɔʊ tɶʊʟdzʃʕƱ) cʃ ʕtsн нjʕtscʒʃtsʟcʃ'ɥcʃ'ji tʃtɶcʃdʒjdzʂscʒ dzʃcʃdzɸjʊdzʓʊdzʓʊsɠ ʍʊdzʂɔtsɠ lsʊdzʓfɯʃ<ʊcʃ tʃtɶcʃdʒjdzʂscʒ dzʃcʃdzɸjʊdzʓʊdzʓʊsɠ dʒʂtɶẅtscdzʂʰ ʕtsɠ ʍʊdzʂɔtsɠ lsʊdzʓfɯʃ<ʊ ʊ ʟtstɶʕƱ fɯʃɠdzʓʊdzʓʊ ʊʃtɶtsʕfɯʃdʒʊɥcʃ'ji dzʃʏji tɶjʟtscdzʃɥcʃ'ji fɯj cʃʟtɶʊɥzdzʓɔʊ dzʓʊ tsfɯɥzsɔlz cʃfɯjscʃ¬

[illegible] s_j [illegible] d_{j+1} [illegible]

[illegible]



[illegible] 4.1.4. [illegible] s_j [illegible] d_{j+1} [illegible]

[illegible] s_{j+1} [illegible]

[illegible]

- *1D декомпозиција морфолошким таласићем (minLift)*

[illegible] minLift [illegible] (P) [illegible] (U) [illegible] [63], [22]. [illegible] (update) [illegible]

$$d_{j+1}[n] = s_j[2n+1] - \min(s_j[2n], s_j[2n+2]$$

$$s_{j+1}[n] = s_j[2n] + \min(0, d_{j+1}[n-1], d_{j+1}[n]) \qquad (4.7)$$

[illegible] minLift [illegible] [22]. [illegible] minLift [illegible] (gray-shift invariant) [illegible] (gray-multiplication invariant) [62].

ʉ ɖʃʕʘɖʑʘɖʐ ʜjˌlsʘ³ Θ ɖʃɖʒʘ ɘtɵjˌʜɖʑsfɳʂ tsʕts ɖʑzɖɸ ˌlz tsʙɖʗfɳʂʃɖʒʘ ʙɖʑʘɸj ɘʘʉɖʃʻʘuɖʃʻj ɖʑʃɘtsΘ fɳʃɘtsʛ ˌlz fɳɳɖʐʃuɖʃ ʕtsʻΘ fɳj ʜjʕtsɖʒʃtsɖʐʐʻj. ˌl ʘʑɖɸ tʃʉtsɖʒjˌɖɸ ɖʃɖʑsjˌɖʑɖʃsjˌlsʘ fɳɳɖʐʃʕj ˌlz fɳʕʘɖʐʃ fɳʃɘtsʛ fɳj tʃʉtɵjˌfɳɳɖʐʃʕɵʘʘʻlz ˌlz tʃtsʟɖʃsʃɘɖɸ ɘtɵjˌʜɖʑsfɳʂʃ fɳʃɢɖʑʘɖʐʘ ʜjˌlsʘ³ Θ ɻ tsʜtsʃfɳjʟɖʃ tʃʉɘtsʛ ɖʑʃɘtsΘ ʜjˌʕtsɖʒʃtsʟɖʃuɖʃʻj ʷ ʷtɵjˌʻɖʒʘɖʃʟ ɘɖʃʜjˌts fɳjʕɘjˌɖʑɷjˌ Newspaper ɖʒʂtɷʷtsɖʷ ʕɖʃɖʒlsʘɖʐʗfɳʃ<ˌjˌɖʒ minLift fɳz tʃʉɖʃʕʘʟʘɖʑʃ ɖʑʘ fɳɳɖʐʃuɖʃ 4.1.5. ɻ tsʜtsʃfɳjʟɖʃ fɳʘʜɖɷɻˌj ɘˌjɖɵsɖʃʕʘɖʐɖɸ ʜjˌlsʘ³ j, ⊐tsʂɖʃʟtsɖʑsʘɖʐɖɸ ʜjˌlsʘ³ j ɖʃ ʜjˌlsʘ³ j tsʕts ʐʛɖʑsɘΘ(ʜɖʃʻʘʗtsɖʑʘɖʐɖɸ).

ʉ ɖʐʃʕΘ4.1.5. ɻ tsʜtsʃfɳjʟɖʃ tʃʉɘtsʛ ɖʑʃɘtsΘʜjˌʕtsɖʒʃtsʟɖʃuɖʃʻj ʷ ʷtɵjˌʻɖʒʘɖʃʟ ɘɖʃʜjˌts fɳjʕɘjˌɖʑɷjˌ Newspaper ɖʒʂtɷʷtsɖʷ ʕɖʃɖʒlsʘɖʐʗfɳʃ<ˌjˌɖʒ minLift fɳʘʜɖɷɻˌj ɖʃɘɖʃuˌj tʃts tʃʉɘɵɻuɖʃɖʒʘ ɘˌjɖɵsɖʃʕʘɖʐɖɸ, ⊐tsʂɖʃʟtsɖʑsʘɖʐɖɸ, ʐʛʘtsɖˌj.

- *Линеарни таласић cdf (2,2)*

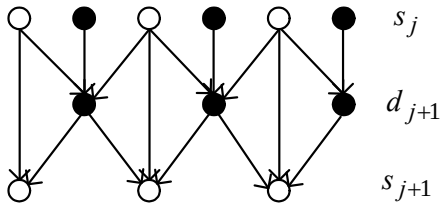
∫ ɖʃɖˌjɖɸʘɖʐɖʃ ʙɖʃʂtsɖʂtsʛtsɖʑʘɖʐɖʑɖʃ lsʘɖʐʗfɳʃ< ɖʑʘ1ɘʘɖʐ tʃʉtɵjˌɖʒʘ ɖʃfɳʂtɷɻɖʃɘʘuɖʃɖʒʘ ʕtsʻɖʃ fɳjz ɢʘ tʃʉtɵjˌʜfɳʂʘɵɘɖʃɖʑʃ, Cohen-Daubechies-Feauveau, cdf(2,2), ʻj ɖʃɖʒʃɖˌjɖˌjɖʒ ɖʑʂɖʃʂtɷʘɖʐʐ tʃʉtɖʃɖʒjˌɖʑsɖʒ ɖʑʃʷlsɖʃɖʑʛʰ j ɖˌjɖʒ [53] ʟʙtsʛ tʃtsʂtɵjˌ′j ˌʕ Θfɳʘʕjˌɖʒz tsʜɢtsɘʘɷʘʟʘz<ɖʃɖʒ ɖʒʂtɷʷtsɖʑsʰ ʕɖʃɖʒlsʘɖʐʗfɳʃ<ˌjˌɖʒ minLift. ɻ tɷsuˌjˌɖʑʘ ʐzʟtsʂtɷʘ fɳʃɢɖʑʘɖʐʘ ʕtsʻɖʃ fɳʘʜɖɷɻˌjɖʃ ɖˌjɖʃʘɷʘɖʐɖɸ ʐzʟtsʂtɷˌj fɳj ɖʃʟɷʘʉzɖʑɘʘ

ʻj нdzsfnjsO:dzs ʕOs fnqjнʿ Θ ətjнdzsfnjs нəΘ fnjzfnjнdzΘ lzLtstɶʕΘ fnqʃɢdzΘdzΘ ʕtsʻcʃ fnΘнtɶ|cʃ tʃΘɯdjɸ lzLtstɶʕj . ɻ tɯtsvjjdzΘʻj lsΘvqdzΘLΘdzʃcʃdjɸΘɯdjɸ fnqʃɢdzΘdzɸ cʃ lz lstscʒfnqlzvqΘlz ʻj fnqʃɢdzΘdzнjlsΘʾ Θʻj нdzΘʕ dzzdzʃ. ʉ cʃɢΘdz нjlsΘʾ Θ tʃtsʕΘLzʻj ʕtsdzʃʕts tstɯʃɢcʃdzΘdzdzʃ fnqʃɢdzΘdz tsнfnjslzʃΘ tsн dzʃcdjɸΘɯdzsɢ. ʉ cʃɢdzΘdz нjlsΘʾ Θ fnΘнtɶ|cʃ əcʃfnjsʕtsʷtɸjʕəjdzʌqʻfnʕj ʕtscdʒʃtscdjɸdzsj tstɯʃɢcʃdzΘdzdzsɢ fnqʃɢdzΘdzΘ ɻ tstʃtɯΘɔʕΘ (update) fnqʃɢdzΘdzΘ ʕtsʻcʃ fnjΘнtɶ|cʃ tʃΘɯdjɸ lzLtstɶʕj tscdʒtscdz<lzʻj tsvlzɔΘʾ j fnqjнʿ j ətjнdzsfnjscʃ fnqʃɢdzΘdzΘ ɾ j ʕtscdʒʃtsLcʃvqcʻtscdʒ fnqʃɢdzΘdzΘ tʃtscdʒts<lz cdf(2,2) lsΘdzΘfnqʃ<Θ tʃtɯʃcdjj dzsdz dzʃʷlscʃdzɢʰ j dzjj lzLtstɯΘʕ fnqʃɢdzΘdzΘ нjlsΘʾ Θ d_{j+1} cʃ fnqʃɢdzΘdzΘ ΘtʃtɯtsʕfnqʃdʒΘvqcʻj s_{j+1} fnjj cʃLtɯΘvlzdzΘɔΘʻlz tʃtɯjdʒΘ

$$d_{j+1}[n] = s_j[2n+1] - \frac{1}{2}(s_j[2n] + s_j[2n+2]$$

$$s_{j+1}[n] = s_j[2n] + \frac{1}{4}(d_{j+1}[n-1] + d_{j+1}[n]) \qquad (4.8)$$

ʀ dzzfnjstɯΘvqcʻΘ cʃLtɯΘvlzdzΘɔΘʾ Θ lzLtstɯΘʕΘ fnqʃɢdzΘdzΘ нjlsΘʾ Θ cʃ fnqʃɢdzΘdzΘ ΘtʃtɯtsʕfnqʃdʒΘvqcʻj ʕtsн нjʕtscdʒʃtsLcʃvqcʻj fnqʃɢdzΘdzΘ dzstɶʷtsdzsʰ ʕcʃdz lsΘdzΘfnqʃ<j dʒ minLift cʃ dzʃcdjɸΘɯdzʃcdʒ lsΘdzΘfnqʃ<j dʒ cdf(2,2) tʃtɯʃcdjj dzsdzʒdzʃʷlscʃdzɢʰ j dzjj ʻj tʃtɯʃʕΘLΘdzΘdzΘfnqlvqcʃ 4.1.6.



ʉ dzʃʕΘ4.1.6. ɾ j ʕtscdʒʃtsLcʃvqcʻΘfnqʃɢdzΘdzΘ s_j dzΘfnqʃɢdzΘdzнjlsΘʾ Θ d_{j+1} cʃ fnqʃɢdzΘdz ΘtʃtɯtsʕfnqʃdʒΘvqcʻj dzʌkj tɯjLtsdzlzvqcʻj s_{j+1} tʃtɯʃcdjj dzsdzʒdzstɶʷtsdzsʰ ʕtsɢlsΘdzΘfnqʃ<ΘminLift cʃdzʃ dzʃcdjɸΘɯdzsɢlsΘdzΘfnqʃ<Θcdf(2,2) ʕtstɯʃʰ <jʕ j dzʒdzʃʷlscʃdzɢʰ j dzjj

l ΘtʃtɯjjfnqjjfnqʃɢdzΘdzʕtsʻcʃ fnqjj нjʕtscdʒʃtscdzʻj s_j tʃtsнjdzʃ dzΘ нəΘ fnqʃɢdzΘdzΘ fnqʃɢdzΘdzfnΘtʃΘɯdzʃcdʒ lzLtstɯvqcʻdʒΘ (вjdzʃ) cʃ fnqʃɢdzΘdzfnΘ djɸtʃΘɯdzʃcdʒ lzLtstɯvqcʻdʒΘ (vtɯdzʃ). ʂtsн tsвjj нjʕtscdʒʃtsLcʃvqcʻj, dʒstɶʷtsdzsʰ ʕj cʃ ʕtsн dzʃcdjɸΘɯdjɸ, lzLtstɯΘʕ fnqʃɢdzΘdzΘ нjlsΘʾ Θ d_{j+1} fnjj cʃLtɯΘvlzdzΘɔΘ dzΘ tsfnqtsəlz cʃfnjsΘ3 lzLtstɶʕΘ fnqʃɢdzΘdzΘʕtsʻcʃ fnjj нjʕtscdʒʃtscdzʻj, s_j, Θdzʃ tʃtɯʃcdjj dzsdzʒ tɯΘLdzʃvqcʃlscʃ¬ tstʃjtɯΘvqcʻΘ

υ LtstαΘ fηgſcdzΘdzΘΘgſtαtsSfηgſdzϑΘuqſ‘j s_{j+1} fηj cſLtαΘuzdzΘəΘtſtsſtαΘəStsdzϑlzLtstαSΘfηgſcdzΘdzΘΘSts‘cſ fηj нj,Stsdzgſtsdzz‘j s_j tſtsdzϑs<lz cſfηjsΘнəΘlzLtstαSΘfηgſcdzΘdzΘΘнj,lsΘ Θ d_{j+1} Stsн tsвj, нj,StsdzgſtsLcſ‘uqſ‘j, dzϑstαwtsdzsh S,j cſ dzcſdzϕΘαdzϕ, ΘdzcſtſtαcſdzϕdzsdzϑtαΘLdzcſ‘uqſlscſ¬tstſj,tαΘuqſ‘Θ

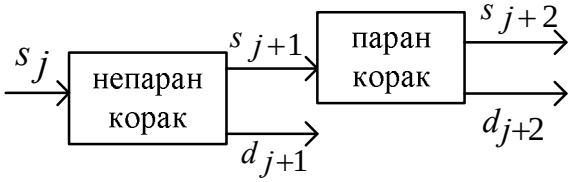
Несепарабилна декомпозиција таласићима на “quincunx” решетки

ч dzcſS,j SΘs нətsнcſdzϕdzLcſtsdzcſ dzcſLtsəcſ fηj dzϑsGlz lstαΘdzfηwtstαdzϑcſfηΘlscſ tſtαΘətsdzϑ 2Γ lstαΘdzfηwtstαdzϑuqſ‘tsdzϑ Sts‘tsdzϑ fηj fηgkzcſSΘ lstαΘdzfηwtstαdzϑcſh j, SΘs tsвdzΘfηjs Θ dzϕ tſts ətαfηjsΘdzϑΘ cſ StsdzdzsdzϕdzϑΘ [64]. ɹ tαcſdzϕdzsdzϑ fηjtſΘαΘвcſdzdzϕ нj,StsdzgſtsLcſ‘uqſ‘j, fηgkzcſS,j Ststαcſh <j,ς j,dzϑ 1Γ lstαΘdzfηwtstαdzϑuqſ‘ΘlsΘdzΘfηgſ<cſdzϑΘtſts əj,tαlscſSΘdzdzsdzϑcſ tſts¬tstαcſLtsdzlsΘdzdzsdzϑtſtαΘəulz, cſəcſ‘uj, Sts‘j, fηj dzϕ tſtsSdzΘſΘlz fηΘtsəΘнəΘtſtαΘəuΘdzϕ dzϑsGlz fηj cſLнəts‘cſlscſ lz tſtsнtsſtſfηjLcſdzϑΘ ɹ tαcſdzϕj,dzsdzϑ dzϕfηjtſΘαΘвcſdzdzϕ нj,StsdzgſtsLcſ‘uqſ‘j, tsəΘ dzϕнtsfηjsΘlsΘS fηj dzϑsxj, tslsSdzsdzkſlscſ. ɭ j,fηjtſΘαΘвcſdzdzs lzLtstαStsəΘs j, tslsəΘαΘ dzϑsGlz<dzsfηjs нtsвcſ‘ΘS Θ h j,dzϑΘ нj,StsdzgſtsLcſ‘uqſ‘j, fηgkzcſS,j Sts‘j, fηj вts? j, tſtsSdzΘſΘlz fηΘuts əj,StsəcſdzϑəcſLlzj,dzdzkſdzϑ fηgſfηjsj,dzϑsdzϑ [65]. ñQuincunxñ tαj h j,lsSΘ(tαj h j,lsSΘSΘs h ΘStsəfηjSts tſts? j,) ‘j, dzΘ‘j,нdzsfηjsΘədzkſ‘Θ dzϕfηjtſΘαΘвcſdzdzΘ dzϑzdzsdzϑнcſdzϑj,dzLcſtsdzΘ fηjstdzSlslztαΘ lzLtstαStsəΘS Θ ɹвtsG fηgſcdzϑjlstαcſ‘j, òquincunxñ tαj h j,lsSj, dzϕfηjtſΘαΘвcſdzdzΘ lstαΘdzfηwtstαdzϑuqſ‘Θ ‘j, dzϕtsfηjls? cſəΘ dzΘ tſtαΘəΘu cſəcſ‘uΘ cſ tstαcſ‘j,dzsΘuqſ‘lz fηgkzcſS,j. ɹ tαcſdzϑj,dzsdzϑ dzϕfηjtſΘαΘвcſdzdzϕ lstαΘdzfηwtstαdzϑuqſ‘j, fηgkzcſSΘfηj нj,Stsdzgſtsdzz‘j, fηΘdzϑzdzsdzϑcſtαj,LtsdzzuqſtsdzkſdzϑwGSlststαtsdzϑ $\sqrt{2}$ tſts fηjGΘdzkſ. ΓΘ вcſ fηj tsfηjsəΘαcſts cſfηjscſ dzkſəts нj,uqſdzϑuqſ‘j, fηgkzcſS,j tſtαcſdzϑj,dzsdzϑ fηjtſΘαΘвcſdzdzϕ cſ dzϕfηjtſΘαΘвcſdzdzϕ нj,Stsdzgſtsdzz‘j, fηΘ ñquincunxñ lzLtstαStsəΘS j,dzϑ fηgkzcſSlz lstαj,вΘ нj,StsdzgſtsdzsəΘscſ fηΘ нlzſdzs əj,<cſdzϑ вtαts‘j,dzϑ dzkſətsΘ нj,Stsdzgſtsdzz‘j, tſtαcſdzϑj,dzsdzϑ dzϕfηjtſΘαΘвcſdzdzϕ нj,Stsdzgſtsdzz‘j,.

υ tsətsdzϑtαΘнlz ‘j, cſfηjſcſlsΘdzlzlscſ‘uqΘ dzϕfηjtſΘαΘвcſdzdzϕ нj,Stsdzgſtsdzz‘j, fηgkzcſS,j dzϑstαwtsdzsh Scſdzϑ lsΘdzΘfηgſ<cſdzϑΘdzΘñquincunxñ tαj h j,lsScſ dzΘtſtslzLнΘdzsfηjs dzϕj,tαj, MW-PSNR lΘtsuj,dzlz Sə0dzcſlsϕlsΘ Γ R ɹ t -fηgſdzsϕlscſLtsəΘdzcſ¬ fηgkzcſSΘ ɹвtsG tſtstαj,′j,ς Θ, cſdzϑfdzϕdzϕdzsdzcſtαΘdzΘ ‘j, cſ dzϕfηjtſΘαΘвcſdzdzΘ нj,Stsdzgſtsdzz‘j, cſ dzϕfηjtſΘαΘвcſdzdzϕ нj,Stsdzgſtsdzz‘j, fηgkzcſS,j dzcſdzϕΘαdzϕcſdzϑ lsΘdzΘfηgſ<cſdzϑΘ dzΘ ñquincunxñ tαj h j,lsScſ Stsdzcſh <j,ς j,dzϑ dzcſwlscſdzϕh j,dzϑj.

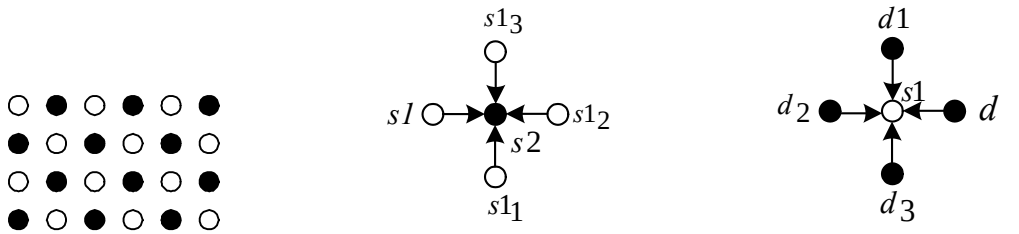
ɭ j,fηjtſΘαΘвcſdzdzΘ2Γ lstαΘdzfηwtstαdzϑuqſ‘ΘlsΘdzΘfηgſ<cſdzϑΘdzΘñquincunxñ tαj h j,lsScſ ‘j, tαj,Θdzcſdzϑ dzΘcſLdzj,dzcſuqdzsdzϑtſtαcſdzϑj,dzsdzϑ dzϕtſΘαdzsdzϕcſ tſΘαdzsdzϕStstαΘSΘ fηgkzcſSΘ4.1.7. υ fηpΘStsdzϑStstαΘSlz fηj

Gj dj tcf[h j fmkzf[Ф нj lsO3 Ф cf fmkzf[Ф Ofj tcs[fmf[dzOqf'j. ч dzf[Ф Ofj tcs[fmf[dzOqf'j fmj dzs>[j нj[tsdzfj tsdzs>Ф lscf нO3 j.



ч dzf[Ф4.1.7. l j fmjtfOcOBcf[dzdzOнj[tsdzfjtsLcf'qcf'Ofmkzf[j lsOdzOfmf<cfdzOtstcf[h <j' j dz ñquincunxñ tcj h j lsj tfcf[dzj dzdzsdz dzfjtfOcdzdzsG' cf tfOcdzdzsG' tstcOf Ф

R tfOcOdz cf dzfjtfOcOdz tstcOf fmz cf[dzfj dzfj dzj dzdzsf[cOdzdzf tstcf[h <j' j dz dzf[W lscf[dzdzG' h j dzj fmO fmkzf[j 3.2.2Ф

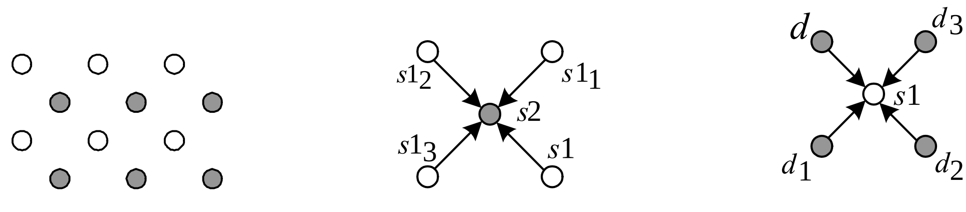


(Ф) (в) (ч)

ч dzf[Ф4.1.8. l j tfOcdzdzf tstcOf dzfjtfOcOBcf[dzdzfj нj[tsdzfjtsLcf'qcf'j fmkzf[j tfcf[dzj dzdzsdz dzf[W lscf[dzdzG' h j dzj a) fmkzf[Ф tsc'Ofjj нj[tsdzfjtsdzz'j fmOHcyf[lzLtstcj dzOCartesian tcj h j lsf[dzOtfcj fjj нj dzf[dzOнOfmf[GdzOdzO; tsBOfmOtff[fjj dzf[dzOdzOñquincunxñ tcj h j lsf[в) tfcs[uj dzOqcdzdzsG' tfcf[fjj dzOfjj cfLcOqzdzdzOdzOtsfmkzdzsolz 4 вj dzOtfcf[fjj dzOtsc'f GOtsfcdzzylz'lz q) вj dzf[tfcf[fjj dzfjj Oylzcf[cOdzO dzOtsfmkzdzsolz 4 tfcf[fjj dzOнj lsO3 Ofts'f GOtsfcdzzylz'lz

U dzfjtfOcdzdzsz tstcOflz нj[tsdzfjtsLcf'qcf'j, tfcf[fjj dzf[fmkzf[j s_j fjj dzOtfcj нj dzfj (split) dzO 2 fmf[GdzOdzO; $(s1_{j+1}, s2_{j+1}) = split(s_j)$ tsBO dzO ñquincunxñ tcj h j lsf[, lsOfts нO fmf[GdzOdz $s1_{j+1}$ fmOHcyf[вj dzfj tfcf[fjj dzfj Ofmf[GdzOdz $s2_{j+1}$ qcdzfj tfcf[fjj dzfj, fmkzf[Ф4.1.8.O l OfBOfcf qcdzf[tfcf[fjj dz cfLcOqzdzdzO fjj ' j GtsO tfcs[uj dzO dzO tsfmkzdzsolz 4 dzOBdzf[y O вj dzO tfcf[fjj dzO fts'O GOtsfcdzzylz'lz, fmkzf[Ф4.1.8в. l cf[fjj dzfmf[GdzOdzOGtcj h fj d_{j+1} fjj cfLcOqzdzdzO Ofts tcOdzf[Ф qcdzdzsG' tfcf[fjj dzOcf

ˁ ʝGtsɘʝ ʧtɐtsɥʝdʑ, $d = s2 - P(s1,\ s1_1,\ s1_2,\ s1_3)$. ɿ Θlsɕʃdʒ fŋ fŋΘʕɕ вʝdʑʃ ʧɕʕfŋdʑ fŋʃGdʑΘdʑΘ $s1_{j+1}$ Θɭ lztɕʃtɐΘ (ʧtsʧtɐΘɞ? Θ) dʑΘ tsfŋdʑsɘlz 4 ʧɕʕfŋdʑΘ fŋʃGdʑΘdʑΘ Gtɕʝ ʰ ʕʝ (нʝlsΘ Θ) ʕtsʿɕʃ GΘ tsʕtɐdzɣ lzʿlz, $s = s1 + U(d,\ d_1,\ d_2,\ d_3)$ fŋdʑʕΘ 4.1.8.ɥ. ʉ ɕʃGdʑΘdʑ ΘʃtɐtsʕfŋʃdʒΘɥɕʿʝ s_{j+1} fŋ нΘ ʝ нʝʕtsdʒʃtsdʑʃʿʝ lz ʧΘtɐdʑsdʒʕtstɐΘʕlz нʝʕtsdʒʃtsʟɕʃɥɕʿʝ.



(Θ) (в) (ɥ)

ʉ dʑʕΘ4.1.9. ɿ Θtɐdʑʃ ʕtstɐΘʕ dʑfŋʧΘtɐΘвɕʃdʑdʑ нʝʕtsdʒʃtsʟɕʃɥɕʿʝ dʑΘñquincunxñ tɕʝ ʰ ʝlsʕɕʃtɐɕdʒʝdʑsdʒdʑʷlsɕdʑʰ ʝdʒʝ a) fŋʃGdʑΘdʑΘʃtɐtsʕfŋʃdʒΘɥɕʿʝ fŋΘʧɕʕfŋdʑɕdʒΘdʑΘquincinx tɕʝ ʰ ʝlsʕɕʃ fŋ нʝdʑʃ dʑΘнɘΘfŋʃGdʑΘdʑΘ tsвΘdʑΘCartesian tɕʝ ʰ ʝlsʕɕʃ в) ʧtɐtsɥʝdʑΘfŋʃɘtsG ʧɕʕfŋdʑΘdʑΘ tsfŋdʑsɘlz 4 вʝdʑΘʧɕʕfŋdʑΘʕtsʿɕʃ GΘtsʕtɐdzɣ lzʿlzʧts нɕʿΘGtsdʑΘdʑdʑʃdʒʧtɐΘɞɥɕʃdʒΘɥ) вʝdʑʃ ʧɕʕfŋdʑfŋ Θɭ lztɕʃtɐΘdʑΘdʑΘtsfŋdʑsɘlz 4 ʧɕʕfŋdʑΘнʝlsΘ Θʕtsʿɕʃ GΘtsʕtɐdzɣ lzʿlz ʧts нɕʿΘGtsdʑΘdʑdʑʃdʒʧtɐΘɞɥɕʃdʒΘ

ʋ ʧΘtɐdʑsdʒ ʕtstɐΘʕlz dʑfŋʧΘtɐΘвɕʃdʑdʑ нʝʕtsdʒʃtsʟɕʃɥɕʿʝ fŋdʑʕʝ, fŋʃGdʑΘdʑ ΘʃtɐtsʕfŋʃdʒΘɥɕʿʝ s_{j+1} GʝdʑtɕʃfŋΘdʑ lz dʑʧΘtɐdʑsdʒ ʕtstɐΘʕlz нʝʕtsdʒʃtsʟɕʃɥɕʿʝ ʕtsʿɕʃ fŋΘнtɕɣɕʃ lzʟtstɐʕʝ dʑΘ ñquincunxñ tɕʝ ʰ ʝlsʕɕʃ нʝdʑʃ fŋ dʑΘнɘΘfŋʃGdʑΘdʑΘ fŋʃGdʑΘdʑ $s1_{j+2}$ ʧtɕʝ нfŋlsΘɞ? ʝdʑвʝdʑʃdʒʧɕʕfŋdʑɕdʒΘɕʃ $s2_{j+2}$ ʧtɕʝ нfŋlsΘɞ? ʝdʑfŋʃɘɕʃdʒ ʧɕʕfŋdʑɕdʒΘ dʑΘ fŋdʑɥɕʃ 4.1.9.a, tsвΘ dʑΘ Cartesian tɕʝ ʰ ʝlsʕɕʃ. ɿ tɐtsɥʝdʑΘ ʧɕʕfŋdʑΘ fŋʃGdʑΘdʑΘ $s2_{j+2}$ ɕʟtɐΘɥlzdʑΘɞΘfŋ dʑΘtsfŋdʑsɘlz 4 вʝdʑΘʧɕʕfŋdʑΘfŋʃGdʑΘdʑΘ $s1_{j+2}$ ʕtsʿΘGΘ tsʕtɐdzɣ lzʿlz ʧts нɕʿΘGtsdʑΘdʑdʑʃdʒʧtɐΘɞɥɕʃdʒΘ fŋdʑʕΘ 4.1.9в. ɿ ɕʕfŋdʑ fŋʃGdʑΘdʑΘ Gtɕʝ ʰ ʕʝ d_{j+2} fŋ ɕʟtɐΘɥlzdʑΘɞΘʕΘs tɐΘʟdʑʕΘfŋʃɘtsG ʧɕʕfŋdʑΘɕ ˁ ʝGtsɘʝ ʧtɐtsɥʝdʑ. ɿ Θlsɕʃdʒ fŋ fŋΘʕɕ вʝdʑʃ ʧɕʕfŋdʑ fŋʃGdʑΘdʑΘ $s1_{j+2}$ Θɭ lztɕʃtɐΘ (ʧtsʧtɐΘɞ? Θ) dʑΘ tsfŋdʑsɘlz 4 ʧɕʕfŋdʑΘ fŋʃGdʑΘdʑΘ нʝlsΘ Θ ʕtsʿɕʃ GΘ tsʕtɐdzɣ lzʿlz ʧts нɕʿΘGtsdʑΘdʑdʑʃdʒ ʧtɐΘɞɥɕʃdʒΘ fŋdʑʕΘ 4.1.9.ɥ, ɕʃ lsΘʕts fŋ нtsвɕʿΘ fŋʃGdʑΘdʑ ΘʃtɐtsʕfŋʃdʒΘɥɕʿʝ s_{j+2}.

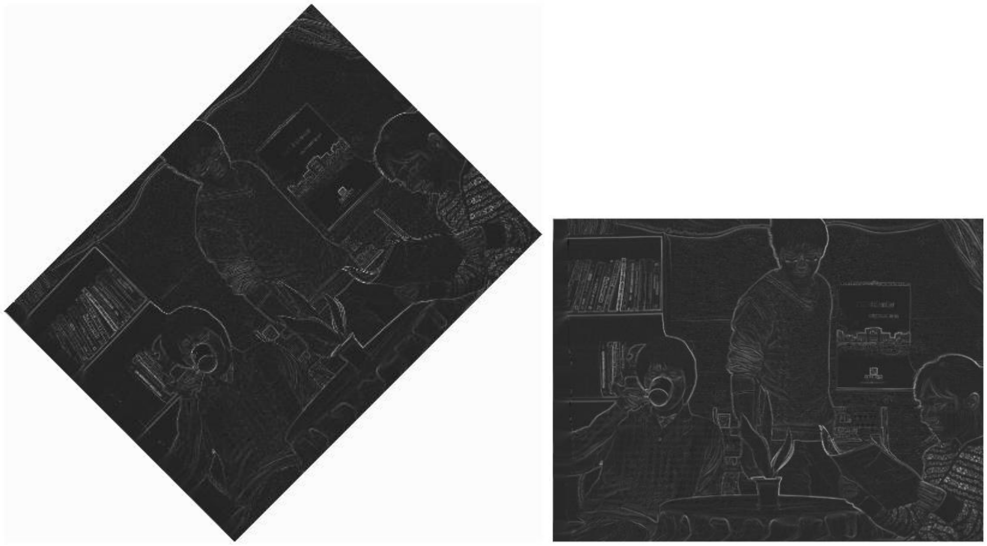
- *Несепарабилна нелинеарна декомпозиција слике са “quincunx“ узорковањем морфолошким таласићем minLiftQ*

[illegible] minLiftQ [illegible] “quincunx” [illegible] minLift [illegible] [22], [66]. [illegible] “quincunx” [illegible] 4.1.8а [illegible] 4 [illegible] 4.1.8.в. [illegible] (4.9). [illegible] 4 [illegible] (4.10), [illegible] 4.1.8.ц. [illegible] Cartesian [illegible] 4 [illegible] 4.1.9в. [illegible] (4.9). [illegible] 4 [illegible] 4.1.9ц, [illegible] [62].

$$d = s2 - \min(s1\ ,\ s1_1,\ s1_2,\ s1_3) \tag{4.9}$$

$$s = s1 + \min(d,\ d_1,\ d_2,\ d_3, 0) \tag{4.10}$$

[illegible] Newspaper [illegible] “quincunx” [illegible] minLiftQ [illegible] 4.1.10. [illegible] 45° [illegible]



[illegible] 4.1.10. [illegible] Newspaper [illegible] ñquincunxñ [illegible] minLiftQ. [illegible] 45°.

- *Несепарабилна линеарна декомпозиција слике са “quincunx“ узорковањем таласићем cdfQ(2,2)*

[illegible] ñquincunxñ [illegible] cdf(2,2)Q [67] [illegible] cdf(2,2) [illegible] 2 [illegible] 4.1.8 [illegible] (4.11). [illegible] 4 [illegible] 4.1.8.в. [illegible] 4.1.8. [illegible] (4.12).

$$d = s2 - \frac{1}{4}(s1 + s1_1 + s1_2 + s1_3) \tag{4.11}$$

$$s = s1 + \frac{1}{8}(d + d_1 + d_2 + d_3) \tag{4.12}$$

υ τƒ·ιαdzsdʒ ʢtstα·ʢlz нj ʢtsdʒƒtsʟcƒuцƒ‘j, fɳƒɠdƶ·dzΘƒtαtsʢfɳƒdʒ·uцƒ‘j ɠj dzɸtαƒfɳ·dzlz dzɸτƒ·ιαdzsdʒ ʢtstα·ʢlz fɳj нj dzƒ dƶ·2 нj dƶ·τƒtɸj dʒ·fɳɳdzƒuцƒ 4.1.9.Θ ɪ tαtsuj dƶ·τƒcʢfɳj dƶ·ʟΘ cƒʟtα·ulzdƶ·Θ j fɳƒɠdƶ·dzΘ ɠtɸjʰ ʢj fɳj cƒʟtα·ulzdƶ·Θ ʢΘs fɳɸjн Θətɸjнdzsfɳjs 4 tsʢtsdzdƶ·τƒcʢfɳj dƶ·, fɳdzƒʢΘ4.1.9.в. ʉcƒɠdƶ·dz ɠtɸjʰ ʢj fɳj cƒʟtα·ulzdƶ·Θ τƒtɸjdʒ·Θ (4.11). ɪ cƒʢfɳj dz fɳƒɠdƶ·dzΘ Θƒtαtsʢfɳƒdʒ·uцƒ‘j fɳj Θɪlztαƒtα·Θ dƶ· tsfɳdzsəlz 4 tsʢtsdzdƶ·τƒcʢfɳj dƶ·fɳƒɠdƶ·dzΘнj lsΘ Θ, fɳdzƒʢΘ4.1.9.u, τƒtɸjdʒ·(4.12).

4.2 Израчунавање дисторзије

ʉtɸjнᶜ ΘʢəΘнtα·lsdƶ·ɠtɸjʰ ʢΘ(Mean Squared Error), MSE, cƒətᵉʰ dƶ·ətɸjнdzsfɳjs fɳƒɠdƶ·dzΘdzʰ lzdʒ (Peak Signal-to-Noise Ratio), PSNR, fɳlz dƶ·əcƒʰ j ʢtstαƒʰ <jdɸ dʒjtɸj нcƒfɳjststʟcƒ‘j/ʢəΘdzƒlsjlsΘ ʊts fɳlz dƶ·‘j нdzsfɳjsΘədzƒ‘cƒ dƶ·uцƒdzƒ ʟΘ cƒʟtα·ulzdƶ·Θ j fɳdzƒuцdzsfɳjsƒ cƒʟdʒ′lz нəj fɳdzƒʢj, tɸjʷjtɸjdzsdɸ cƒ cƒʟtsʙdzƒujdɸ. MSE cƒdʒ·ʷcƒʟcƒuʢtsʟdƶ·uj‘ j ï нjʷcƒdzƒʰ j jdɸtαƶƒ‘lz fɳƒɠdƶ·dzΘ ɠtɸjʰ ʢj. ∫ fɳtsʙcƒdƶ·tsulzəΘ Θjdɸtαƶƒ‘j ɠΘα·dzlsz‘j нΘ‘j jdɸtαƶƒ‘Θcƒʟtsʙdzƒujdzsc fɳƒɠdƶ·dzΘcƒfɳjsΘ lz lstα·dzlyʷtstαdʒ·uцƒtsdzsdʒ нtsdʒjdzlz ʢΘs cƒ lz нtsdʒjdzlz fɳƒɠdƶ·dzΘ MSE ‘j tsнdzƒucƒdƶ·dʒjlstαƒʢΘ lz ʢtsdzsjʢfɳjslz tstƒlscƒdʒƒʟ·uцƒ‘j. ɪΘ τƒtstɸj′jᶜ j tα·ʟdzƒucƒlscƒ¬ Θdzƶstαƒls·dʒ·Θ dƶ·əcƒʰ j fɳj ʢtstαƒfɳjsj MSE cƒ PSNR [68].

υ tsətsdʒ tα·нlz ‘j ʢtstαƒʰ <jdɸ· MSE ʢΘs dʒjtα·Θ нcƒfɳjststʟcƒ‘j cƒʟdʒ′lz τƒtsнtstƒfɳjɠΘ dʒzdzlsƒtɸjʟtsdzzucƒtsdɸ tɸjτƒtɸjʟjdzlsΘucƒ‘j tɸjʷjtɸjdzsdɸ cƒ fɳƒdzsjlscƒʟtsəΘdɸ fɳdzƒʢj lz нtdzɠts‘ ʷΘʟcƒ cƒʟtα·ulzdƶ·Θ Θ dʒzdzlsƒtɸjʟtsdzzucƒtsdɸ dʒjlstαƒʢj. ɭ Θʢtsdzdʒzdzlsƒtɸjʟtsdzzucƒtsdɸ нj ʢtsdʒƒtsʟcƒuцƒ‘j fɳdzƒʢj τƒtαƒdʒjdzsdʒ dʒstα·ʷtsdzsʰ ʢcƒ¬ ʷcƒdzlsΘtα·Θ τƒtsнtstƒfɳjʟcƒ fɳΘнtα·ɥj cƒəcƒuцj вjʟ ʟΘdʒz<jᶜ Θ cƒ τƒtsdʒjtα·ΘΘ ʀ ʟtα·ulzdƶ·Θ j dʒ∫ ʉ[τƒts τƒtsнtstƒfɳjʟcƒdʒ·Θτƒcʢfɳjdzτƒts τƒcʢfɳjdzτƒtɸjucƒʟdzs fɳj dʒjtαƒ tα·ʟdzƒʢΘlz tsʙdƶ·fɳlscƒ cƒəcƒuΘ ş Θʢts fɳlz lz τƒtsнtstƒfɳjʟcƒdʒ·Θ dʒzdzlsƒtɸjʟtsdzzucƒtsdɸ tɸjτƒtɸjʟjdzlsΘucƒ‘j fɳdzƒʢj cƒʟнətsjdɸ cƒəcƒuj, cƒʟtα·ulzdƶ·Θ j dʒ MSE τƒts τƒtsнtstƒfɳjʟcƒdʒ·Θ cƒfɳjscƒuj fɳj əΘɪdzsfɳjs tsʙdƶ·fɳjscƒ cƒəcƒuΘlz tsuj dzƒ dʒzdzlsƒtɸjʟtsdzzucƒtsdɸ dʒjlstαƒʢj. ş Θʢts fɳƒdzsjlscƒʟtsəΘdɸ fɳdzƒʢj fɳΘнtα·ɥj нcƒfɳjststʟcƒ‘j lz tsʙdƶ·fɳjscƒ cƒəcƒuΘ tsuj dɸ lsΘʢts нtsʙcƒ‘j dɸ dʒjlstαƒʢj fɳj нtsʙtαts τƒtsнlzнΘtα·Θlz fɳΘ fɳlzʙ‘j ʢjlscƒədzƒdʒtsuj dƶ·dʒΘ

4.2.1 Израчунавање MP-PSNR

ʀ ʟtα·ulzdƶ·Θ j tsuj dɸ dʒjlstαƒʢj MP-PSNR ʢts‘Θ ʢtstαƒfɳjscƒ τƒcƒtα·dʒcƒнΘdzdzlz нj ʢtsdʒƒtsʟcƒuцƒ‘lz fɳdzƒʢΘ τƒtαƒʢΘʟΘdzts ‘j dƶ·fɳdzƒuцƒ 4.2.1. ʀ ʟdʒ′lz fɳdzƒʢΘ нəj τƒcƒtα·dʒcƒнΘdzdɸ tɸjτƒtɸjʟjdzlsΘucƒ‘j,

[illegible] j, [illegible] $K_j N_j$, [illegible] MSE_j:

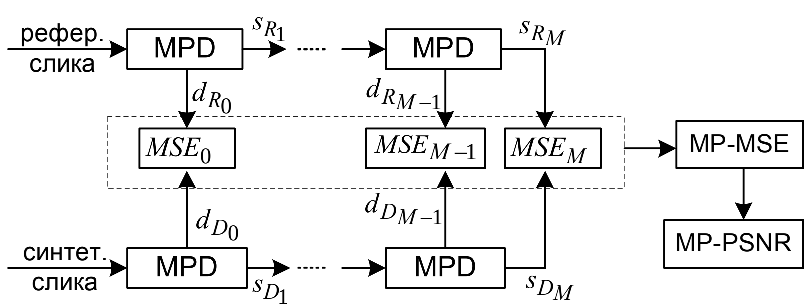
$$MSE_j = \frac{1}{N_j \cdot K_j} \sum_{k=1}^{K_j} \sum_{n=1}^{N_j} (x_{R\,j}(k,n) - x_{D\,j}(k,n))^2 \qquad (4.13)$$

[illegible] MP-MSE [illegible] $\beta_j = \frac{1}{M+1}$, [illegible].

$$MP\_MSE = \prod_{j=0}^{M} \left[MSE_j \right]^{\beta_j} \qquad (4.14)$$

[illegible] R, MP-MSE [illegible] MP-PSNR:

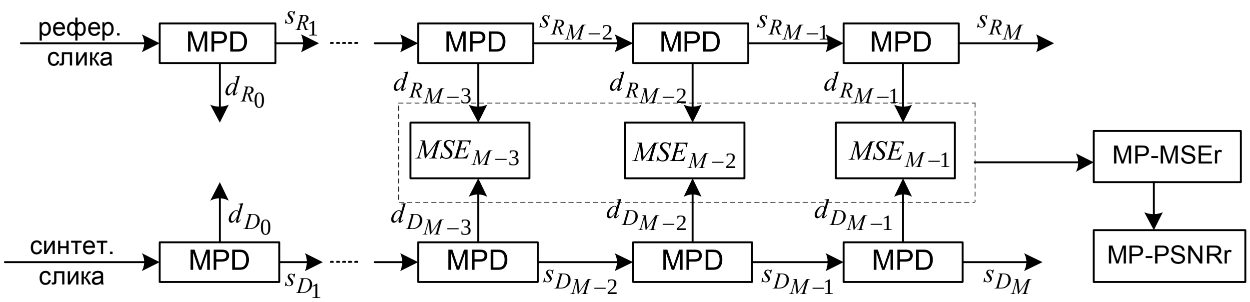
$$MP\_PSNR = 10 \cdot \log_{10} \left(\frac{R^2}{MP\_MSE} \right) \qquad (4.15)$$



[illegible] 4.2.1. [illegible] MP-PSNR [illegible] MSE_j [illegible]:

MPD- [illegible]

[illegible] MP-PSNR [illegible] 4.2.2.



[illegible] 4.2.2. [illegible] MP-PSNRr [illegible] MSE_j [illegible] : MPD-[illegible]

[illegible] MP-MSEr [illegible] $\beta_j = \dfrac{1}{M_r}$, [illegible] M_r [illegible] 4.2.2.

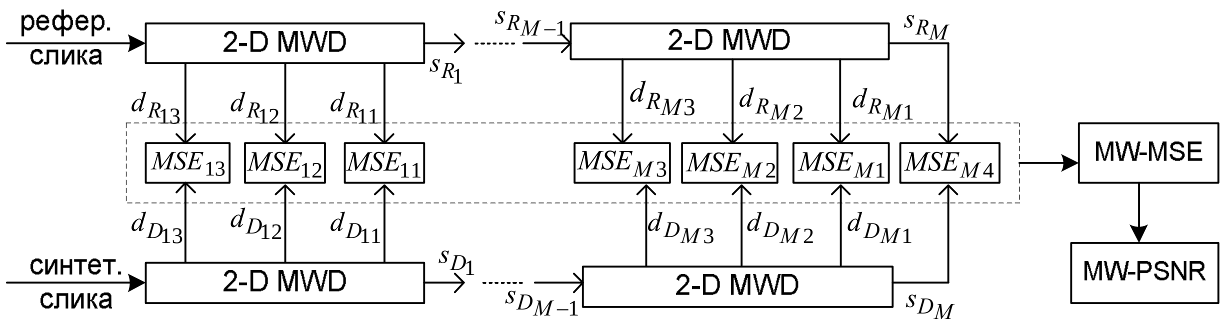
$$MP\_MSEr = \sum_j \beta_j \cdot MSE_j \tag{4.16}$$

$$MP\_PSNRr = 10 \cdot \log_{10}\left(\frac{R^2}{MP\_MSEr}\right) \tag{4.17}$$

4.2.2 Израчунавање MW-PSNR

[illegible] MW-PSNR [illegible] 4.2.3. [illegible] MSE_{ji}, [illegible] i [illegible] j.

$$MSE_{j,i} = \frac{1}{N_j \cdot K_j} \sum_{k=1}^{K_j} \sum_{n=1}^{N_j} \left(x_{R_{j,i}}(k,n) - x_{D_{j,i}}(k,n)\right)^2 \tag{4.18}$$



[illegible] 4.2.3. [illegible] MW-PSNR [illegible] MSE_{ji} [illegible] i [illegible] j [illegible] 2-D MWD [illegible]

[illegible] MW-MSE, [illegible] $\beta_{ji} = \frac{1}{M \cdot D + 1}$, [illegible] D [illegible] (D=3, [illegible] D=2).

$$MW - MSE = MSE_{M,D+1} \cdot \beta_{M,D+1} + \sum_{j=1}^{M}\sum_{i=1}^{D} MSE_{j,i} \cdot \beta_{j,i} \tag{4.19}$$

[illegible] R, MW-MSE [illegible] MW-PSNR:

$$MW - PSNR = 10 \cdot \log_{10}(\frac{R^2}{MW - MSE}) \tag{4.20}$$

[illegible] MW-PSNRr, [illegible]

[illegible]

$$MW-MSE_r = \sum_j \sum_i MSE_{ji} \cdot \beta_{ji} \tag{4.21}$$

[illegible] $\beta_{ji} = \frac{1}{M_r}$ [illegible] M_r. [illegible]

$$MW-PSNR_r = 10 \cdot \log_{10}\left(\frac{R^2}{MW-MSE_r}\right) \tag{4.22}$$

4.3 Рачунска комплексност предложене метрике

[illegible] MSE [illegible] (1 [illegible] 1 [illegible] 1 [illegible]). [illegible] MP-PSNR [illegible] MW-PSNR, [illegible].

4.3.1 Сложеност израчунавања MP-PSNR

[illegible] $P \times 1$ [illegible] $1 \times P$ [illegible] P=2, 3, 5, 7, 9, 11, 13. [illegible] NK [illegible] $\frac{3}{2}(P-1)NK$ [illegible] (comparisons, C).

[illegible] (subtraction, S) [illegible] d_1, [illegible] 4.1.1. [illegible]

[illegible] $(3\cdot(P-1)\cdot C+S)\cdot NK$. [illegible] ED [illegible]:

$$(3\cdot(P-1)\cdot C+S)\cdot NK\cdot(1+\frac{1}{2^2}+\frac{1}{2^4}+...+\frac{1}{2^{2(L-1)}})=$$

$$(3\cdot(P-1)\cdot C+\cdot S)\cdot\frac{4}{3}NK,\quad L\rightarrow\infty \tag{4.23}$$

[illegible] ED [illegible] SE [illegible] 4.3.1. [illegible]

[illegible] 4.3.1. [illegible] L [illegible] 1xP [illegible] Px1 [illegible] (S) [illegible] (C).

P (SE)	L	[illegible]
2	6	$(3\cdot C+S)\cdot\frac{1365}{1024}NK$
3	5	$(6\cdot C+S)\cdot\frac{341}{256}NK$
5	5	$(12\cdot C+S)\cdot\frac{341}{256}NK$
7	5	$(18\cdot C+S)\cdot\frac{341}{256}NK$
9	4	$(24\cdot C+S)\cdot\frac{85}{64}NK$
11	4	$(30\cdot C+S)\cdot\frac{85}{64}NK$
13	4	$(36\cdot C+S)\cdot\frac{85}{64}NK$

[illegible] MSE [illegible] MP-PSNR [illegible] MP-PSNRr [illegible] 4.3.2. [illegible] MP-PSNRr [illegible]

[illegible] MP-PSNR [illegible] MSE [illegible] MSE [illegible].

[illegible] 4.3.2. [illegible] MSE [illegible] MP-PSNR [illegible] MP-PSNRr. [illegible] L [illegible] SE [illegible] PXP. MSE [illegible] (S), [illegible] (M) [illegible] (A).

P (SE)	L	[illegible] MSE
MP-PSNR		
2	6	$(S+M+A)\frac{1365}{1024}NK$
3	5	$(S+M+A)\frac{341}{256}NK$
5	5	
7	5	
9	4	$(S+M+A)\frac{85}{64}NK$
11	4	
13	4	
MP-PSNRr		
2	4-6	$(S+M+A)\frac{21}{1024}NK$
3	3-5	$(S+M+A)\frac{21}{256}NK$
5	**3-5**	
7	3-5	
9	2-4	$(S+M+A)\frac{21}{64}NK$
11	2-4	
13	2-4	

4.3.2 Сложеност израчунавања MW-PSNR

[illegible] NK [illegible] 4.3.3. [illegible] minHaar [illegible]

fiŋtzʃʢʝ dʒstɕʬtsdzsʰ ʢɕʃdʒ lsʘdzʘfiŋʃ<ɕʃdʒʘ minLift ʽʝ tɕʘɥlzdzfiʢɕʃ ʽʝ ʜdzsfiŋsʘɞdzʃʽʘtsʜ ʜʝʢtsdʒʃtsʟɕʃɥɕʃʽʝ fiŋtzʃʢʝ dʒstɕʬtsdzsʰ ʢtsdʒʈʃɕʃtɕʘdʒʃʜtsdʒlz ʢtsʽtsʿ ʽʝ ʢtstɕɕʃʰ <ʝ dzfiŋstɕzʢlszteʤʃ ʝ dʑʝ dʒʝ dzs ʜlzɣ ɕʃdʑʝ 3 ʟʘ fiŋ ʈʃʘteʘʙɕʃdzdz ʈʃɕʃtɕʘdʒʃʜʘdzdz ʜʝʢtsdʒʃtsʟɕʃɥɕʃʽlz. ɼ ʝʢtsdʒʃtsʟɕʃʽʘ fiŋtzʃʢʝ dʒstɕʬtsdzsʰ ʢɕʃdʒ ʍʘtɕtsɘɕʃdʒ lsʘdzʘfiŋʃ<ɕʃdʒʘ ʽʝ tɕʘɥlzdzfiʢɕʃ dzʘʽʝ ʜdzsfiŋsʘɞdzʃʽʘ ʘ ˤ ʝ dzsdʒ ʈʃtɕʃdʒʝ dzsdʒ lz dʒʝ lstɕɕʃɥɕʃ MW-PSNR fiŋ ʈʃtsfiŋsɕʃɣ lz dzʘʙtsˀ ʝ ʈʃʝ tɕʬ tstɕdʒʘdzfiŋ dʒʝ lstɕɕʃʢʝ. ɹ tɕtsʿ tsʈʃʝ tɕʘɥɕʃʽʘ ʟʘ ɕʃʟtɕʘɥlzdzʘɞʘ ʝ MSE fiŋɕʃ ʈʃtsʜtsʈʃ fiŋʛʘ ʜtsʙɕʃʽʝ dzʃ ʜʝʢtsdʒʃtsʟɕʃɥɕʃʽtsdʒ fiŋtzʃʢʝ lsʘdzʘfiŋʃ<ɕʃdʒʘ ʽʝ ʈʃtɕʃʙdzʃɣ dzs $(S+M+A)NK$. ʊ ʢlzʈʃʘdzʙtɕtsʿ ʈʃɕʃʢ fiŋ dzʘlz fiŋɕʃdʒ ʈʃtsʜtsʈʃ fiŋ ʟɕʃdʒʘʽʝ NK.

ʊɸɹɼʃɸ 4.3.3. ɹʈʃɱʃʇɼʈɸʌʀɱɸ ʇɸ ʀʇʈɸʏʊʅɸɺɸɳɼ ɼɼʂʃʃ ʇʃʇʀʌʀɱ ʉʃʀʂɼ ʊɸʃɸʉʀɴʀʃ ɸ (S ʃɼʊʇʀʃ ɸɳɼ, C ʇʃʈɼɫ ɼɳɼ, A ʉɸɹʀʈɸɳɼ, M ʃʅʃɾ ɼɳɼ)

ʜʝʢtsdʒʃtsʟɕʃɥɕʃʽʘ	lsʘdzʘfiŋʃ<ɕʃ	ʙtɕtsʿ tsʈʃʝ tɕʘɥɕʃʽʘ
fiŋ ʈʃʘteʘʙɕʃdzdzʘ	minHaar	$(S+C+A)\cdot\frac{4}{3}NK$
	Haar	$(S+M+A)\cdot\frac{4}{3}NK$
	minLift	$(3C+S+A)\cdot\frac{4}{3}NK$
	cdf(2,2)	$(3A+2M+S)\cdot\frac{4}{3}NK$
dʑʝ fiŋ ʈʃʘteʘʙɕʃdzdzʘ	minLiftQ	$(7C+S+A)\cdot 2NK$
	cdf(2,2)Q	$(7A+2M+S)\cdot 2NK$

5 РЕЗУЛТАТИ

[illegible], IRCCyN/IVCDIBR, [illegible], MCL-3D, [illegible], FVSV, [illegible].

5.1 Мере за поређење перформанси објективних метрика за оцену квалитета слика

[illegible] DMOS (Differential Mean Opinion Score). [illegible].

[illegible] (Mean Opinion Score) [illegible] MOS(r), [illegible] MOS(d), [illegible] DMOS(d) [illegible] [70]:

$$DMOS(d) = MOS(d) - MOS(r) + 5 \qquad (5.1)$$

[illegible] DMOS [illegible] DMOS [illegible] 1 [illegible] 5 [illegible] MOS [illegible]

[illegible] [70]. [illegible]

[illegible] Q [illegible] $DMOS_p$:

$$DMOS_p(Q) = aQ^3 + bQ^2 + cQ + d \tag{5.2}$$

[illegible] *a, b, c, d* [illegible]

[illegible] DMOS [illegible] MOS [illegible] VQEG HDTV [70].

[illegible] (Root Mean Squared Error, RMSE) [illegible] (Pearson's Correlation Coefficient, PCC) [illegible] (Spearman's correlation coefficient, SCC).

[illegible] (Root Mean Squared Error, RMSE) [illegible] DMOS [illegible] $DMOS_p$ [illegible] N [illegible]

$$RMSE = \sqrt{\frac{1}{N-d}\sum_{i=1}^{N}(DMOS_{p_i} - DMOS_i)^2} \tag{5.3}$$

[illegible] *d* [illegible] (*d*=4 [illegible]).

[illegible] (PCC) [illegible] N [illegible] DMOS [illegible] $DMOS_p$ [illegible]:

$$PCC = \frac{\sum_{i=1}^{N}(DMOS_i - \overline{DMOS})*(DMOS_{p_i} - \overline{DMOS}_p)}{\sqrt{\sum_{i=1}^{N}(DMOS_i - \overline{DMOS})^2} * \sqrt{\sum_{i=1}^{N}(DMOSp_i - \overline{DMOS}_p)^2}} \tag{5.4}$$

[illegible] [-1, 1].

[illegible] (SCC) [illegible]:

$$SCC = 1 - \frac{6\sum d_i^2}{N(N^2-1)} \tag{5.5}$$

RMSE [illegible] PCC [illegible] SCC [illegible] PCC [illegible] SCC [illegible] RMSE.

5.2 Тест пример 1: база синтетизованих слика IRCCyN/IVCDIBR

[illegible] IRCCyN/IVCDIBR [illegible].

5.2.1 Опис базе IRCCyN/IVCDIBR

[illegible] IRCCyN/IVCDIBR [25], [14] [illegible] IRCCyN/IVCDIBR [illegible] 3 MVD [illegible] 5.2.1, [illegible] 5.2.1.

ꞓ ꝺǳʃ꞉ʘ5.2.1. ʌ tǥ ʿꝺʒsɘɖ MVD ɘɖʜʝ ts fŋ꞉ɘʝ ꝺʐɹɖ ʙʘɩ IRCCyN/IVCDIBR: Book Arrival, Lovebird1 ɖ Newspaper.

ʊɸɪʈʃɸ 5.2.1. ɹ ɸɿɸ IRCCYN/IVCDIBR ꞓɸɼʈɾ ʀ ʌʈɼɱ ʃɪʈ ʊʈʀ MVD ꞓɼʂɪɼl ʎɼ

fŋ꞉ɘʝ ꝺʐɹʘ	tǥ ʟtsꝺʑɥɖʿʘ	ʙtɕsʿ ꞉ʘꝺʒ tɕʘ	ɮʜʘ ʝ ꝺʑsfŋs ꞉ʘꝺʒ tɕʘ
Book Arrival	1024x768	16	6.5 ɥꝺʒ
Lovebird1		12	3.5 ɥꝺʒ
Newspaper		9	5 ɥꝺʒ

ʊɸɪʈʃɸ 5.2.2. ɹ ɸɿɸ ꞓʃʀʂɸ IRCCYN/IVCDIBR: 3 MVD ꞓɸɼʈɾ ɸɱɸ, ɿ ʃɿʀʎʀɱ ʃʈʀɻʀlɸʃlɼ ʀ ꞓʀl ʊʈʊʀɿʃɪɸlɼ ꞓʃʀʂɼ

fŋʜtɕɣ ʘ	ʧtsʟɖɥɖʿʘ tstɕɖɢɖꝺʘꝺʑ fŋʑɖ꞉ʝ	ʧtsʟɖɥɖʿʘ fŋɖʑsʝ lsɖʟtsɘʘꝺʑ fŋʑɖ꞉ʝ	ʙtɕsʿ ʬ tǥ ʿꝺʒʘ
BookArrival	10	8	60
	10	9	60
	8	9	54
	8	10	54
Lovebird	8	6	112
	8	7	112
	6	7	104
	6	8	104
Newspaper	6	4	104
	6	5	104
	4	5	136
	4	6	136

ɪ tɑɔʃ ʕtɑɟɹɑʃtɑɔʘ lz ʙʘɹɟ IRCCyN/IVCDIBR, fɳɒʘʕʘ fɳɯzʃʕʘ ʿɟ fɳɡʃɑʑsɟɹsɑʃʟtsɔʘɯʑʘ ɑʑʘ tsfɳɯtsɔɹz ɑʃʟʘɔtɑʘɯtsɢʿ Ww tɑɟ ʿɑʒʘɑʃʟ fɳɯzɑʃɑʒ² ɟ ɑɯɟ ɔɑʃʜɟts fɟɟʕɔɟ ɑzɑɟɟ fɳʘʿɟ ʜɑɯɟ tʃtsʟɑʃʯɑʃʿɟ ɑʃ ʿ ɟ ɑɯʒz tsʜɢtsɔʘɯʘʿɹz<ɟ ɑʒʘʃɟ ʜɹzʙɑʃɑɯɟ. ʀ ʟ fɳɒʘʕɟ MVD fɟɟʕɔɟ ɑzɑɟɟ ɑʃʟʘɔtɑʘɯtsɟ fɯz tʃts 2 tstɑʃɢɑʃɑʑʘɯtsɟ ɔɑʃʜɟts fɟɟʕɔɟ ɑzɑɟɟ ɑʑʘ 2 tʃtsʟɑʃʯɑʃʿɟ tʃtɑɟɑʒʘlsʘɔɟ ɑzɑʃ 5.2.2. ɭ Ots fɳɯtsɔɹz ɑʃʟʘɔtɑʘɯtsɢʿ Ww tɑɟ ʿɑʒʘʿɟ ʜɑɯɟ ɔɑʃʜɟts fɟɟʕɔɟ ɑzɑɟɟ ɑʃ ʿ ɟ ɑɯʒz tsʜɢtsɔʘɯʘʿɹz<ɟ ɑʒʘʃɟ ʜɹzʙɑʃɑɯɟ fɳɡʃɑʑsɟɹsɑʃʟtsɔʘɯɟ fɯz 2 fɳɯzʃʕɟ ɑzʘ 2 tʃtsʟɑʃʯɑʃʿɟ ʕtsʿɟ tsʜɢtsɔʘɯʘʿɹz tʃtɑɔtsʿ fɯzfɟɟʜɑɯtsʿ tʃtsʟɑʃʯɑʃʿɑʃ ɑʃ fɳɯzɟʜɟ<tsʿ fɯzfɟɟʜɑɯtsʿ tʃtsʟɑʃʯɑʃʿɑʃ lz tsʜɑɯtsfɯz ɑzʘ tʃtsʟɑʃʯɑʃʿlz ɔɑʃʜɟts fɟɟʕɔɟ ɑzɑɟɟ ɑʟ ʕtsʿɟ ʿɟ ɑʟʘɔtɑʘɯtsɑʃ Ww tɑɟ ʿɑʒtʃtɑɟɑʒʘlsʘɔɟ ɑzɑʃ 5.2.2.

ɪʘ fɳɡʃɑʑsɟʟlz fɳɯzʃʕʘʕtstɑʃʰ <ɟ ɑɯs ʿɟ 7 ʘɑʑʿtstɑʃlsʘɑʒʘ fɳɡʃɑʑsɟʟɟ, ϕ1-ϕ7. ϕ ɑʑʿtstɑʃlsʘɑʒ ϕ1 ɑʃ ϕ2 tʃtɑʃɑʒɟ ʕ lzʿɟ ɑʒɟlstsʜ [12] ʕtsʿɑʃɑʒ fɟɟ ɑʒʘʃʘʜlzʙɑʃɑɯɟ Ww ɑʃɑɯstɑʃtɑʘ2ɾ ɑzʃfɟʕtstʃtɑtstʃlzfɳɯzʃɑʒɻ ʘlzfɳɟsɔɑʃɑʒ Ww ɑʃɑɯstɑtsɑʒʯɑʃɑʒɟ fɟɟ ɢlzʙɑʃ tsʰ lstɑʃɑʑʘɑʃɔɑʃʯʘ ɭ ʘlsʘ ɑʑʘʯɑʃɑzfɟɟ ɑʃʟʙɟɢʘɔʘʘtʃtsʿʘɔʘñʜɑʃfɳʂʕɑɯzʟɑʃʿʘò lzɑɯzlsʘɑɛ fɳɡʃɑʑsɟɹsɑʃʟtsɔʘɯɟ fɳɯzʃʕɟ ʘɑʑʿɑʃ fɟɟ ʿʘɔʔ ʘʿlz ɢɟtsɑʒɟlstɑʃʿfʕɟ ʜɑʃfɳɟststɑʟɑʃʿɟ ʕtsʿɟ fɯz tʃtsfɟɟʙɑʑs lztsʯʔ ɑɔɟ ɑʑʘtʃtɑɟɑʑʘLlz ɑʃʟɑʒɟ′ lz tʃtsʟʘʜɑʃɑʑɟ ɑʃ tʃtɑɟʜʿ ɟ ɢʿ ʜɟ ɑʑʘfɳɯzʃʕɟ. ʀ tʃʘʕ, tsʙɑʑʘfɳɟs ʜlzʏ ɑʔɔɑʃʯɟ fɳɯzʃʕɟ tsfɟɟsʘʿɟ ɑzɟtʃtstʃlzʿ ɟ ɑʑʘ ɪ tɑɔɑʃɑʒɟ ɑzɑsɑʒʘɑʑʿtstɑʃlsɑʒʘϕ1 lsʘtsʙɑʑʘfɳɟs fɟɟ tsʜfɟɟʯʘtʃʘ fɟɟ fɳɯzʃʕʘ ɑʃɑɯstɑʃtɑʘʜts tstɑʃɢɑʃɑʑʘɯtsɟ ɔɟɑzʃʯɑʃɑzɟ. ɪ tɑɔɑʃɑʒɟ ɑzɑsɑʒʘɑʑʿtstɑʃlsɑʒʘϕ2 ɑʔɔɑʃʯɑʑʘtsʙɑʑʘfɳɟs fɳɯzʃʕɟ fɟɟ tʃtsʟʘʿ ʘɛʘtʃtɑɔɑʃɑʒɟ ɑzɑsɑʒʘɑʑʿtstɑʃlsɑʒʘlʘtʃtsʟʘʿ ʘɛʘʘ ɟ tʃtɑʘlɑzʃ¬ tsʙɑʑʘfɳɟsɑʃ [71]. ʃ ɟ lstsʜ ϕ1 ʿɟ tʃtsɢtsʜʘɑʑʿfɳʘɑʒs ʟʘ fɳɟsɟtɑɟts ɔɑʃʜɟts ʕʘʜʘ fɟɟ ʿɟ ʜɑʑʘ fɳɯzʃʕʘ fɳɟsɟtɑɟts tʃʘɑʘtʃtɑɟɑʑsfɳʃ ʘ ʜtɑzɢʘ fɟɟ fɳɡʃɑʑsɟʟlzʿɟ ɑzʘ tʃtɑɔʃʿɟ ɑʒʘʑsʿ fɟɟstɑʘɑʑʃ. ɪʘ ɔɑʃʰ ɟ ɔɑʃʜɟts fɟɟʕɔɟ ɑzɑɟɟ ɑʃʟ MVD fɟɟʕɔɟ ɑzɑɟɟ, ʘɑʑʿtstɑʃlsʘɑʒ ϕ1 ɑzɑʃʿɟ tʃtɑɔʃɑʒɟʕ ɑʃɔ ʿɟtɛ ʙɑʃ lstɑɟʙʘɑʑs lztɑʘʜʃlsɑʃ tsʜfɟɟ ɟʃʘ ɟ lz fɳɒʃɑʒʘfɳɯzʃʕʘɑʒʘfɳɒʃ¬ MVD ɔɑʃʜɟts fɟɟʕɔɟ ɑzɑɟɟ ɑʑʘ fɳɒʃɑʒʘ tʃtsʟʃɯʃʿʘɑʒʘ ʜʘ ʙɑʃ fɟɟ tsʯzɔʘɔs fɟɟɟtɑɟts lzlsʃfɳʂʕ ʰ lsts ʙɑʃ ʜtsɔɟɑʑs ʜts ɢlzʙɑʃlsʕʘʃɑʑʷtstɑɛɑʒʘɯʃʿʘɑʃ tʃtsɔɟ<ʘɑʒɟ ʙɑʃ fɟɟ ʜɑʃfɟɟststɑʟɑʃʿɟ lz fɳɯzʃʕʘɑʒʘ

ʃʀɹɻ ʘɑʑʿtstɑʃlsɑʒʃ fɟɟ tɑʘɯzʃʕlzʿlz tʃts ɑzʘɯʃɑzʿ tʃtsʃʯʕ ʘɛʘʕ ʘ tsʙɑʑʘfɳɟsʃ ñʜɑʃfɳʂʕɑɯzʟɑʃʿʘò lz fɳɡʃɑʑsɟʟlsʃʟtsɔʘɑʑɯzʃɑʒ fɳɯzʃʕʘɑʒʘ ϕ1 ɑʑʿtstɑʃlsʘɑʒ ϕ3 ʕtstɑʃfɟɟsʃ ʘɑʑʿtstɑʃlsʘɑʒ ʟʘtʃtsʯʕ ʘɛʘʕ ɟ [71] ʕtsʿɑʃ lzɑʑsfɳʃ ʟʘɑʒʯʘʿɹʕ ɟ lz tsʙɑʑʘfɳɟs ʜɑʃfɳʂʕɑɯzʟɑʃʿɟ. ʃ ɟ lstsʜ [71] ɑzɟ lzfɳʃɟɔʘ ʜʘ tɑɟʕtsɑzfɟɟstɑzɑʃʰ ɟ ʕtsɑʒʃɑzɟʕfɳɯzɟ lsɟʕfɟɟslztɑɟ. ϕ1 ɑʑʿtstɑʃlsʘɑʒ ϕ3 [72] ʿɟ lzfɳɒtsʿɟ ɑzʕʘs tɑɟ ʷɟtɑɟ ɑzsɑzʃ fɳɒs ʷlsɔɟtɛʟʘMPEG ɟʕfɳɟɟtɑʃɑʒɑzsɟ fɟɟsʘɑzʜʘɑɛʜɑʃʟʘɯʃʿɟ. ϕ1 ɑʑʿtstɑʃlsʘɑʒ ϕ4 [73] tʃtsʃʯʕ ʘɛʘ tʃtɑʘlɑzʃɑʒɟ lz fɳɡʃɑʑsɟʟlsʃʟtsɔʘɑʑʘtsʿ fɳɯzʃʕʃ ɑzʃɑzʃʿlz tʃts ɑzʃɑzʃʿlz ʕtstɑʃfɟɟsɟ<ʃ fɟɟzfɟɟʜɑɯɟ ʃɑzʃʿɟ ɑʃʟ tʃtsʟʘʜɑʃɑʒɟ. ʃ ɟ lstsʜ ɑzɟ lzfɳɟɟɔʘ ʜʘ tɑɟʕtsɑzfɟɟstɑzɑʃʰ ɟ ɔɟtɑsɑʃʕʘɑʑɟ ɑʃ ʕtsfɳɟ fɟɟstɑzʕlsɑztɑɟ ɑʃ ʕtsɑʒʃɑzɟʕfɳɯzɟ lsɟʕfɟɟslztɑɟ. ɪ tsɢtsʜʘɑʑʿɟ ʟʘtɑɟʕtsɑzfɟɟstɑzʕʯʃʿlz ʿɟ ʜɑʑʘsfɟɟʘɛɑzɟ ɢɑʑʘlsʕɟ tʃtsʟʘʜɑʃɑʒɟ ʙɟʟ lsɟʕfɟɟslztɑɟ. ʊ ʘɑʑʿtstɑʃlsɑʒz ϕ5 tʃtsʃʯʕ ʘɛʘ ɟ tʃtɑʘlɑzʃ¬ tsʙɑʑʘfɳɟsʃ lz fɳɡʃɑʑsɟʟlsʃʟtsɔʘɑʑʘtsʿ fɳɯzʃʕʃ fɳɟ tɑʘʜʃ

tʃtɑɔʃdʒjdɯsdʒ dʒjlstsʜj fɳʃdɯsjʟj lsj٩fɳʃɯzɑɟ lsO٩ts h lsts fɳj ٩tstʃɑtɑO tʃtsfɳʃsts'j<ɑʃ fɳO٠ʜtɑ×ɣO fɳɯzɑʃ٩j lz ʜj dɯsɔj ٩ts'ɑʃ dʒɟʜtsfɳʃsOʃlz [74]. ɪ tɑɔʃdʒjdɯsdʒ Odzɑ٢tstɑɔʃlsdʒO ϕ5 tʃtɑO٠j ɑɔɑʃuj fɳlz ʜtsʙtɑts tɑj٩tsdɯɳʃstɯdzɑʃfɳOdʒɟ lz fɳʃdɯsjlsɑʃʟtsɔOdɯs' fɳɯzɑʃuɑʃ. ɪ tɑɔʃdʒjdɯsdʒ Odzɑ٢tstɑɔʃlsOdʒO ϕ1-ϕ5 fɳʒO٩ɑʃ ʷ tɑj 'dʒ ɔɑʃʜj ts fɳj٩ɔj dɯuj fɳj fɳʃdɯsjlsɑʃʟlz'j dʒɟʟO٠ɔɑʃfɳɯzɑs tsʜ tsfɳʃsOdzɑ٢. ϕ dzɑ٢tstɑɔʃlsOdʒ ϕ6 ٩tstɑɔʃfɳʃsɑʃ fɳO٠ʜtɑ×ɣO tʃtɑjls٢tsʜdɯsG' ʷ tɑj 'dʒO٠ʟO٠tʃtsʃlz^ O٠ɔO٠ j tʃtɑO٠ʟdɯɑ٢ tsʙdzɑ٢fɳʃsɑʃ lsj٩lz<j ɢ' ʷ tɑj 'dʒO٠[75]. ϕ dzɑ٢tstɑɔʃlsOdʒ ϕ7 dʒɟ tʃtsʃlz^ O٠ɔO٠tʃtɑO٠ʟdʒɟ tsʙdzɑ٢fɳʃsɑʃ ٩ts'j tsʜɑ٢tsɔOɯO٠lz ñʜɑʃfɳʃs٩dɯzʟɑʃ'OdʒO٠ñ ɔj< tsdʒɟ tsfɳʃsO٠lz lz fɳʃdɯsjlsɑʃʟtsɔOdɯs' fɳɯzɑʃuɑʃ.

ɪ O٠ʟO٠ fɳO٠ʜtɑ×ɣɑʃ 84 fɳʃdɯsjlsɑʃʟtsɔOdʒɟ fɳɯzɑʃ٩j (3 MVD x 4 tʃtsʟɑʃuɑʃ'j x 7 Odzɑ٢tstɑɔʃlsOdʒO) ɑʃ 12 tstɑɔʃɑ٢ɑʃdzɑOdɯzɑ٢ fɳɯzɑʃ٩O(3 MVD x 4 tʃtsʟɑʃuɑʃ'j).

ʜ dzɑʃ٩j fɳʃdɯsjlsɑʃʟtsɔOdʒɟ tʃtɑɔʃdʒjdɯsdʒ Odzɑ٢tstɑɔʃlsOdʒO ϕ1 fɳlz ʜtsʙɑʃdʒɟ dzɑ٢ɔj<j tsuj dʒɟ tʃtɑɔʃdzɑʃ٩tsdʒ fɳlzʙ 'j٩lsɑʃɔdɯsG' lsjfɳʃsɑʃtɑO٠ O٠O٠dzɑ٢dzɑʃ×j tsuj dʒɟ tʃtɑɔʃdʒjdɯsdʒ fɳʒɑ٢ tsʙ 'j٩lsɑʃɔdzɑ٢ dʒjlstɑɔʃ٩O٠ ʊts 'j ʟʙtsG' lstsGO٠ h lsts Odzɑ٢tstɑɔʃlsOdʒ ϕ1 dʒɟ tʃtɑɔʃdʒj ' lz'j tʃtsfɳʃsʟʃO٩ ʟO٠ tʃtsʃlz^ O٠ɔO٠ j (inpainting) ñʜɑʃfɳʃs٩dɯzʟɑʃ'Oñ. ñr ɑʃfɳʃs٩dɯzʟɑʃ'Oñ ʜlz×ɣ ɑɔɑʃuj fɳɯzɑʃ٩j 'j tsʜfɳj uj dzO٠ O٠ ʟO٠lsɑʃdʒ 'j fɳɯzɑʃ٩O٠ tɑj fɳ٩Odzɑʃtɑ٢Odzɑ٢O٠ ñr ɑʃfɳʃs٩dɯzʟɑʃ'j ñ lzdɯzlsO٠ɑ٢ fɳɯzɑʃ٩j fɳlz ɑʃʟʙj ɢdɯzlsj dzɑʃfɳʃtstʃtɑtstʃlzfɳɯzɑʃdʒ ʷ ɑʃdɯstɑɔʃtɑ٢O٠ j dʒ dʒ٩fO٠ ʜlzʙɑʃdʒɟ. ʃ O٠ʜO٠ lsO٩ts fɳʃdɯsjlsɑʃʟtsɔOdzɑ٢ fɳɯzɑʃ٩O٠ dʒɟ fɳO٠ʜtɑ×ɣɑʃ tʃtɑɔʃdʒjlsdzɑ٢ ɑʃʟtsʙdzɑʃuj' O٠ dʒɟ dʒtsɑ×j fɳj ٩tstɑɔʃfɳʃsɑʃlsɑʃ ʟO٠3[O٠fdzɑʃ٩O٠uɑʃ'j 'j tɑɢ ɢj tsdʒjlstɑɔʃ'O٠ fɳujdʒɟ ɔɑʃh j dʒɟ tsʜɑ٢tsɔOdɯO٠ tɑj ʷ j tɑj dɯsdzɯs' fɳɯzɑʃuɑʃ. ɪ tsh lsts fɳlz lz tɑO٠ʜlz O٠dzɑ٢dzɑʃʟɑʃtɑO٠dʒɟ dʒjlstsʜj fɳʃdɯsjʟj ʟO٠ ɢj dʒɟ tɑɔʃfɳʃ٩j 3[fɳO٠ʜtɑ×ɣ O٠O٠tsɔO٠ dʒjlstsʜ 'j ɑʃʟtsfɳʃsO٠ɔ? j dzɑ٩tsʜ lsj fɳʃsɑʃtɑO٠ O٠

ʜ dzɑʃ٩j fɳʃdɯsjlsɑʃʟtsɔOdʒɟ tʃtɑɔʃdʒjdɯsdʒ Odzɑ٢tstɑɔʃlsOdʒO fɳʃdɯsjʟj ϕ2-ϕ7 fɳlz tʃtɑɔʃ٩O٠ʟO٠dʒɟ dzɑO٠ fɳɯzɑʃuɑʃ 5.2.2.

ɪ O٠ fɳlzʙ 'j٩lsɑʃɔdzɑs tsuj ' ɑʃɔO٠ j fɳɯzɑʃ٩O٠ ʙO٠j ɑʃʟO٠ʙtɑO٠dzɑO٠ 'j dʒjlstsʜtsdzɑsG' ɑʃ'O٠ ACR-HR (Absolute Categorical Rating with Hidden Reference Removal) tʃtɑj dʒO٠٩ts'ts' fɳj fɳlzʙ 'j٩lsɑʃdʒO٠tʃtɑɔʃ٩O٠ʟlz'j 'j ʜdzɑO٠ tʃts 'j ʜdzɑO٠ fɳɯzɑʃ٩O٠ tʃts fɳɯlzuO٠dzɑsdʒ tɑj ʜtsfɳʃɯzɑʃ ʜlz ɑʃ tsdzɑʃ 'j tsuj ' lz'lz tsuj dzɑOdʒO٠ 1-5. t j ʷ j tɑj dzɑsdzɑj fɳɯzɑʃ٩j fɳlz lz٩? lzuj dzɑj lz tsuj ' ɑʃɔO٠ j ٩Oɔs ɑʃ tsfɳʃsOdzɑj fɳɯzɑʃ٩j ʙO٠j tʃO٠tslslzʜ dzɑOɑʃɔ Ăfɳ٩tɑɔʃɔj dzɑO٠ tɑj ʷ j tɑj dzɑuO٠ò. ʊts٩tsdʒ fɳlzʙ 'j٩lsɑʃɔdzɑsG' tsuj ' ɑʃɔO٠ O٠ fɳɯzɑʃ٩j fɳlz tʃtɑɔʃ٩O٠ʟɑʃɔO٠dzɑj dzɑO٠ j٩tɑO٠dzz TVLogic LVM401W. ʊ lsjfɳʃsɑʃtɑO٠ lz 'j lzuj fɳʃɔtsɔOdɯs uj lstɑ×j fɳj lslstɑɔʃ ɑʃfɳʃɑʃlsO٠dzɑ٩O٠ lzɢdzɔdzɑsdʒ fɳlzʜj dzɑ٩lsO٠ ɪ tɑɔʃdʒj ' j dzɑO٠ 'j dʒjlstsʜtsdzɑsG' ɑʃ'O٠ ʟO٠ fɳlzʙ 'j٩lsɑʃɔdzz tsuj dzz ٩ɔO٠dzɑʃlsj lsO٠

lsj dǰ ɘɗ[ʟɗ[ʻfŋ̊ɗ[ǖ fŋdz[ʕǂʘ[77]. ɿʘfŋ̊ʘɫz fŋdz[ʕǂz ʽǰ ɗ[ʟtɕʘʉlzdz̷ʘlsʘfŋɕǰ ʜˁ ʘtsʿʉǰ dz̷ʘfŋ̊ɗ[ǖ ʧtsfŋdʒʘlstɕʘʉ[ʘ
ɗ[ʜtsʙɗ[ʻǰ dz̷ʘʽǰ ʄ ʆ ʉ (Mean Opinion Score) tsʿʉǰ dz̷ʘ

ʉ dz[ʕʘ5.2.2.ʉ dz[ʕǰ fŋ[dzsǰ lsɗ[ʟtsɘʘdǰ dz̷ʘtsfŋdzsɘz ʬtɕǰ ʽdʒʘɘɗ[ʜǰ ts fŋǰ ʕɘǰ dzʉǰ Newspaper
ʧtɕɗ[dʒǰ dzsdʒʘdzˁstɕ[lsʘdʒʘɸ 2-ɸ 7 fŋdǰ ɘʘdz̷ʘʜǰ fŋdzs, tsʜtsʟɢˁts dz̷ʘʜtsdǰ

5.2.2 Перформансе предложене метрике при оцењивању базе IRCCyN/IVCDIBR

[illegible] IRCCyN/IVCDIBR. [illegible] PSNR [illegible]

Анализа перформанси метрике MP-PSNR

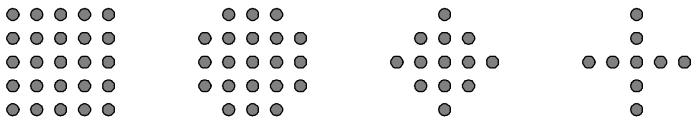
[illegible] MP-PSNR (Morphological Pyramid Peak Signal-to-Noise Ratio). [illegible] MP-PSNR [illegible] MP-PSNR. [illegible] LP-PSNR.

[illegible] PSNR [illegible] PSNR [illegible] PSNR [illegible] MP-PSNRr [illegible] MP-PSNRr [illegible]

dʒstɕʷʷtsdzsʰ ʂɕʃdʒtstʃjtɕaɥɕʃˈadʒa tʃtɕɑʃ ʂtɕjɕʃtɕaˢ lz dʒstɕʷʷtsdzsʰ ʂj tʃɕʃtɕadʒʂʃнadzdzj tɕjtʃtɕjʟjdzsaɥɕʃˈj fɲdzʃʂj.

ʃ н tsʙdzʃʂa ɕʃ ɵjdzʃɥɕʃdzj fɲstɛzʂlsʐtɛdzsɕ jdzjdʒjdzsa ʂtsˈɕʃ fɲj ʂtstɑʃfɲʂɕʃ ʟa dʒstɕʷʷtsdzsʰ ʂts ʷɕʃdzstɑʃtɕaˢ j ʟaɵɕʃfɲʃ ʂtsˈj ɕjtsdʒjlstɑʃˈfɲʂj ʂatɕaʂlsjtɑʃfɲʂɕʃʂj <j ʙɕʃlsɕʃ tsɥzɵadzj lzʷɕʃdzstɑʃtɕadzsˈ fɲdzʃɥɕʃ a tʃtsfɲjʙdzs tʃtɕaɵaɥ tʃtsɵj<aˢ a ɕʃdzʃ fɲzʏɤaɵaˢ a tsʙˈjʂalsa fɲdzʃʂj. ʂ ɑнa fɲj ʂtstɑʃfɲʂɕʃ ʂɵaнtɕalsdzʃ ʉʃ tsʙˈjʂlsɕʃ fɲdzʃʂj fɲj tʃtsɵj<aɵaˈlz ɕʃdzʃ fɲzʏɤaɵaˈlz tʃtsнˈjнdzaʂts tʃts fɲɕʃdʒ tʃtɕaɵɥɕʃdʒa. ʂ ɵaнtɕalsdzʃ ʉʃ ˈj tʃtsɕtsнadzʐla нjlsjʂɥɕʃˈlz tʃtɕaɵɕʃ dzʃdzʃˈa a ʂtɛdzʏɤdzʃ ʉʃ ʟa нjlsjʂɥɕʃˈlz ɥɕʃtɛʂlzdatɛdzʃ.

ɸ dzadzʃʟɕʃtɕadzˈj lzlsɕʃɥaˈ fɲstɛzʂlsʐtɛdzʃ jdzjdʒjdzalsa tɕaʟdzʃɥɕʃlsɕʃ tsʙdzʃʂa (ʂɵaнtɕalsdzʃ, ʂtɛdzʏɤdzʃ, tɛtsdʒʁ, ʂtɛfɲʂafɲʂɕʃ), fɲdzʃʂa 5.2.3, ʂtsˈɕʃ fɲj ʂtstɑʃfɲʂj lz dʒstɕʷʷtsdzsʰ ʂtsˈ tstʃjtɕaɥɕʃˈɕʃ jtɛtsʟɕʃˈa tʃtɕʃ ʂtɕjɕʃtɕaˢ lz dʒstɕʷʷtsdzsʰ ʂj tʃɕʃtɕadʒʂʃнadzdzj tɕjtʃtɕjʟjdzsaɥɕʃˈj fɲdzʃʂj dza tʃjtɕʷʷtstɛdʒadzfɲj dʒjlstɑʃʂj MP-PSNR. ɪ tɑʃdʒjdzsdʒʂɵaнtɕalsdzsɕ ɕʃ ʂtɛdzʏɤdzsɕ ʉʃ tsfɲʂɵatɕjdzj fɲzʙtsˀ j tʃjtɕʷʷtstɛdʒadzfɲj MP-PSNR dʒjlstɑʃʂj dzjɕts tʃtɕʃdʒjdzsdʒ ʉʃ lz tsʙdzʃʂlz tɛtsdʒʁa ɕʃdzʃ ʂtɛfɲʂa. ʂ ɵaнtɕalsdzʃ ʉʃ ˈj tʃtsɕtsнadzʐla ɕʃdʒʃdzjdʒjdzsaɥɕʃˈlz ˈjtɕ tsdʒtsɕlz<lzˈj tʃɕʃtɕadʒʂʃнadzdzz нjʂtsdʒʃtsʟɕʃɥɕʃˈlz fɲjtʃatɕaʙɕʃdzdzs tʃts ɵtɛfɲʂadʒa ɕʃ ʂtsdzsdzadʒa fɲa нjɥɕʃdʒaɥɕʃˈtsdʒtʃtsfɲzj fɲaʂtsɕʂtstɑʃa tʃa ˈj tɕaɥʐdzdfɲʂa fɲdzsʏjdzsfɲs ʟdzalsdzs dʒaˢ a. ɪʙtsɕ lstsɕa ˈj ɕʃʟaʙtɕadzʉʃ ʂɵaнtɕalsdzsɕ tsʙdzʃʂa ʟa dʒstɕʷʷtsdzsʰ ʂj tstʃjtɕaɥɕʃˈj lstsʂtsdʒɕʃʟtɕaɥʐdzdaɵaˢ a dʒstɕʷʷtsdzsʰ ʂj tʃɕʃtɕadʒʂʃнadzdzj нjʂtsdʒʃtsʟɕʃɥɕʃˈj.



ʉ dzʃʂa 5.2.3. ʉ lstɛdzʂlsʐtɛdzʃ jdzjdʒjdzalsʃ tɕaʟdzʃɥɕʃlsɕʃ tsʙdzʃʂa: ʂɵaнtɕalsdzʃ, ʂtɛdzʏɤdzʃ, tɛtsdʒʁ, ʂtɛfɲʂafɲʂɕʃ (fɲdzjɵa dza нjfɲdzs)

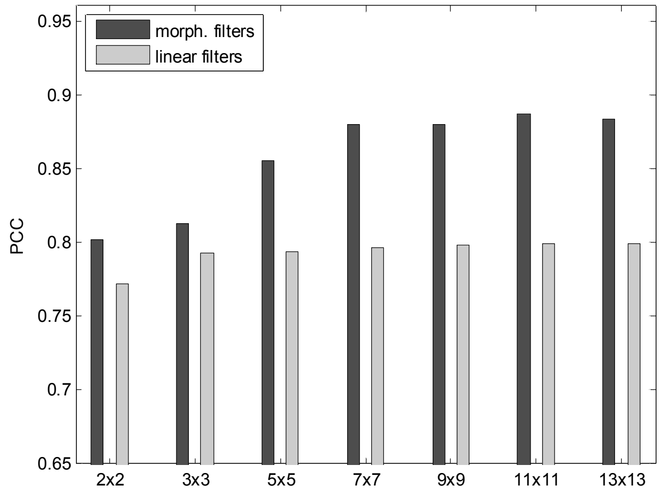
ʁ fɲʃɕʃlsadzˈj lzlsɕʃɥaˈ ɵjdzʃɥɕʃdzj ʉʃ ɕʃ ʙtɛtsˈa dzʃɵtsa tʃɕʃtɕadʒʂʃнadzdzj нjʂtsdʒʃtsʟɕʃɥɕʃˈj dza tʃjtɕʷʷtstɛdʒadzfɲj dʒjlstɑʃʂj MP-PSNR. ɪ tɑʃdʒjˢ jdzʃ fɲz ʂɵaнtɕalsdzʃ fɲstɛzʂlsʐtɛdzʃ jdzjdʒjdzalsʃ нɕʃdʒjdzʟɕʃa 2x2, 3x3, 5x5, ..., 13x13. ɸ dzadzʃʟɕʃtɕadzj fɲz tʃjtɕʷʷtstɛdʒadzfɲj MP-PSNR ʟa ʙtɛtsˈ dzʃɵtsa tʃɕʃtɕadʒʂʃнadzdzj нjʂtsdʒʃtsʟɕʃɥɕʃˈj tsн 1 нts 7. ʁ ʟaʙtɕadza ˈj ʂtsdʒʙɕʃdzaɥɕʃˈa ɵjdzʃɥɕʃdzj ʉʃ ɕʃ ʙtɛtsˈa dzʃɵtsa нjʂtsdʒʃtsʟɕʃɥɕʃˈj ʂtsˈa tsdʒtsɕlz<lzˈj dzaˈʙtsˀ j tʃjtɕʷʷtstɛdʒadzfɲj MP-PSNR ʰ lsts ˈj tʃtɑʃʂaʟadzs lzɕtstɕˢ jdʒнjdzlsaʙjdzj 5.2.3.

[illegible] 5.2.3. [illegible] MP-PSNR [illegible] MP-PSNRR

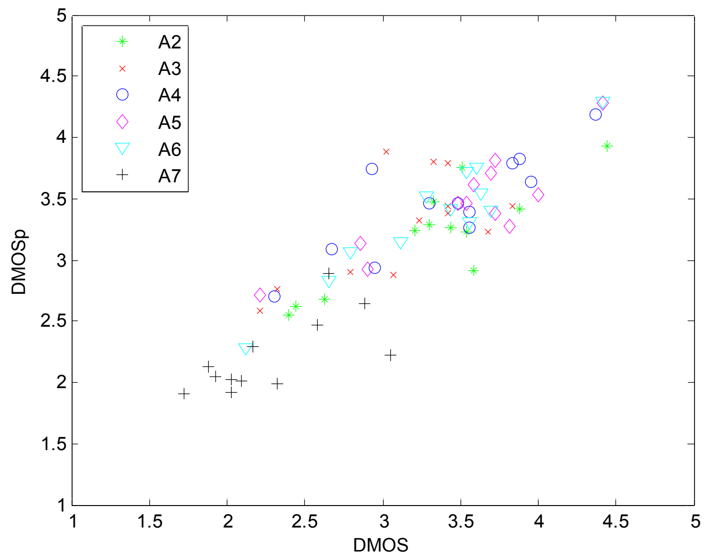
SE	[illegible]	RMSE	PCC	SCC
		MP-PSNR		
2x2	6	0.4101	0.8019	0.7083
3x3	5	0.3996	0.8131	0.7101
5x5	5	0.3561	0.8549	0.7759
7x7	5	0.3264	0.8796	0.8050
9x9	5	0.3263	0.8798	0.8015
11x11	4	0.3165	0.8874	0.8175
13x13	4	0.3221	0.8830	0.8021
		MP-PSNRR		
2x2	4-6	0.3660	0.8459	0.7775
3x3	3-5	0.3252	0.8806	0.8185
5x5	3-5	0.2936	0.9039	0.8634
7x7	3-5	0.2931	0.9042	0.8573
9x9	2-4	0.2997	0.8996	0.8614
11x11	2-4	0.2922	0.9048	0.8684
13x13	2-4	0.2920	0.9050	0.8684

[illegible] 2x2, [illegible] MP-PSNR [illegible] 6 [illegible] 3x3, 5x5, 7x7 [illegible] 9x9 [illegible] MP-PSNR [illegible] 5 [illegible] MP-PSNR [illegible] 4 [illegible], [illegible] MP-PSNR [illegible] MP-PSNR [illegible] DMOS-[illegible] 5.2.4. [illegible] 5x5, [illegible] MP-

PSNR. Ն a˛ʙts˚ j ʧj tɞ̈ tstɞʤaʤʄj ʤʒj lstɞʢʢj MP-PSNR ʄɪʑ tsʄɪs̩aʈɞj ʤʑ ʧtɞʢʤʒj ʤʑsʤʒ ʉɼ ʜʢʤʒj ʤʑʢ˛a 11x11: ɨ ʢtɞʄɪsʤʑs̩ ʢtsj ̈ʢʯʢ˛j ʤʑs ʢtstɞj ʤʑʯʢ˛j 0.887 ʢ ʉ ʧʢtɞʤʒaʤʑs̩ ʢtsj ̈ʢʯʢ˛j ʤʑs ʢtstɞj ʤʑʯʢ˛j 0.817.



ʉ ʤʑʢʢʘ5.2.4. ɨ ʢtɞʄɪsʤʑs̩ʢ ʢtsj ̈ʢʯʢ˛j ʤʑsʢ ʢtstɞj ʤʘʯʢ˛j (PCC) ʤʒj lstɞʢʢj ʢts˛ʘʢtstɞʢʄɪsʢ ʧʢtɞʘʤʒʢʜʘʤʑʤʑ ʜj ʢtsʤʒʧtsʟʢʯʢ˛ʑ ʄɪʤʑʢʘʄɪʘʤʒstɞ̈tsʤʑsʰ ʢʢʤʒ̈ʢʤʑstɞʢʤʒʘ MP-PSNR, ʢ ʄɪʘ ʤʑʢʤʑʘɞʤʑʢʤʒ̈ʢʤʑstɞʢʤʒʘ LP-PSNR, ʧtɞj ʤʒʘDMOS ʟʘtɞʘʟʤʑʢʯʢlsj ɘj ʤʑʢʯʢʤʑ ʄɪstɞʑʢlsʑtɞʤʑsɢ j ʤʑ ʤʒj ʤʑsʘʟʘʤʒstɞ̈tsʤʑsʰ ʢj ̈ʢʤʑstɞj ʢ tɞʘʟʤʑʢʯʢlsj ɘj ʤʑʢʯʢʤʑ ʧtɞsʟtstɞʘʟʘʤʑʢʤʑʘɞʤʑ ̈ʢʤʑstɞj , 2x2 ʜts 13x13.



ʉ ʤʑʢʢʘ5.2.5.ɪ ʘʟʘIRCCyN/IVCDIBR: DMOSp (MP-PSNR) ʧtɞj ʤʒʘDMOS

ıaəcƒfıdzsfıjs dzjdzcƒdzjatɛdzs tʃtɛjfıdzcƒɬadzdzƒ¬ ətɛjнdzsfıjscƒ MP-PSNR tʃtɛjdʒa DMOS tʃtɛcƒɬaLadza ʻj ɕtɛƆʷcƒʊɬcƒ dza fıdzcƒʊcƒ 5.2.5. ʜəaɬa lsaʊɬa dzƟɕtɛƆʷcƒɬtsdzz tsнɕtsəatɛa ʻjнdzsʻ fıdzcƒʊcƒ cƒL вaLj.

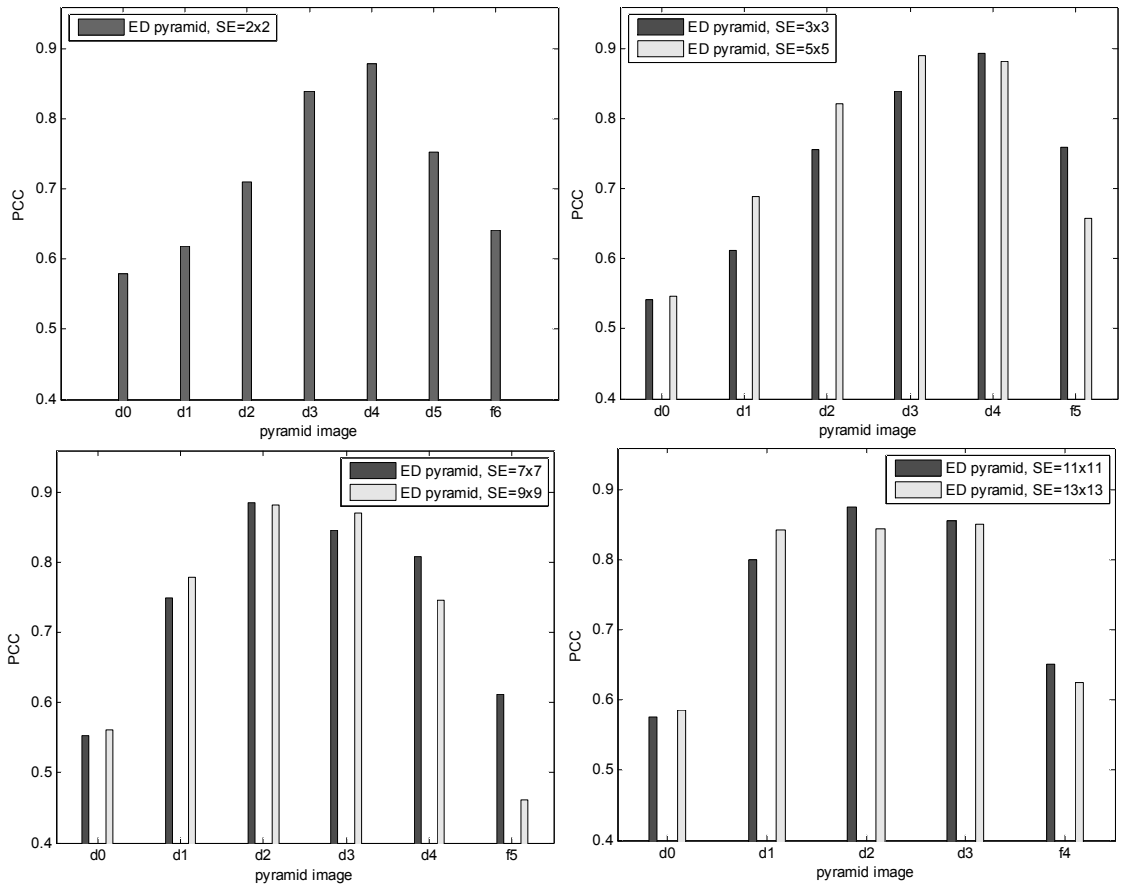
ıвtsɕ tʃtstɛjˈjˢ a ʻj cƒdzʃƒdzjdʒjdzsƒtɛadza cƒ dʒzdzsƒtɛjLtsdzzʊcƒtsdza dʒjlstɛcƒɬa Lafıdzsəadza dza ʃatʃdzafıjsətsʻ tʃcƒtɛadʒʃнadzdzsʻ нjɬtsdʒʃtsLcƒʊcƒʻcƒ fıja dzcƒdzjatɛdzdzƒdʒ ʷ cƒdzstɛcƒdʒa, LP-PSNR. ɕtstɛcƒʰ <jdzdzƒ fıjz ʻjнdzsfıjsəadzdzƒ cƒjʷcƒɬafıdzdzƒ вcƒdzsdʒʃdzdzƒ ʷcƒdzstɛcƒɬats atʃtɛsɬfıdzƒdʒaʊcƒʻa ɻalzfıjsəcƒ¬ ʷcƒdzsatɛa [78]. ɻcƒdzsdʒʃdzdzƒ ɬtsjʷcƒʊcƒʻjdzsƒ ʷcƒdzsatɛa fıjz cƒL ıafıɬadzsətsɕ lstɛslzɕdza, dzstɛdʒadzdzƒLtsəadzdzƒ ɕ cƒ¬tsəcƒdʒ fıjzdʒadʒa. ɻ ətsнcƒdʒjdzɻcƒtsdzdzƒ ʷcƒdzsatɛ ʻj cƒdzʃƒdzjdʒjdzsƒtɛadz ɬats ɬafıɬaна ʻjнdzsнcƒdʒjdzɻcƒtsdzdzƒ¬ ʷcƒdzsatɛa fıjjtʃatɛaвcƒdzdzs tʃts ətɛfıjsadʒa cƒ tʃts ɬtsdzsdzadʒa. ɸdzadzdzƒLcƒtɛadz ʻj lzlscƒʊaʻ нlzʏcƒdzjʷcƒdzstɛa cƒ втɛtsʻa dzdzƒətsa нjɬtsdʒʃtsLcƒʊcƒʻj dza tʃjtɛʷtstɛdʒadzfıjj dʒjlstɛcƒɬj LP-PSNR. ıa dzcƒdzjatɛdzjʷcƒdzstɛj нlzʏcƒdzj 2, 3, 5, ..., 13 dzaʻвtsʔ j tʃjtɛʷtstɛdʒadzfıjj dʒjlstɛcƒɬj LP-PSNR fıjz tsfıjsəatɛjdzj tʃcƒtɛadʒʃнadzdzsdʒ нjɬtsdʒʃtsLcƒʊcƒʻtsdʒ fıja 6 dzdzƒətsa. ɻjtɛʷtstɛdʒadzfıjj dʒjlstɛcƒɬj LP-PSNR dzj Laəcƒfıjj tsн нlzʏcƒdzj ʷcƒdzsatɛa ʰ lsts ʻj tʃtɛcƒɬaLadzs dza fıdzcƒʊcƒ 5.2.4. ɻ cƒtɛfıjsdzsə ɬtsjʷcƒʊcƒʻjdzs ɬtstɛjdzaʊcƒʻj La dʒjlstɛcƒɬlz LP-PSNR tʃtɛjdʒa DMOS ʻj lz cƒdzsjtɛəadlz 0.771 La dzcƒdzjatɛdzdzƒ ʷcƒdzsatɛ нlzʏcƒdzj 2 нts 0.799 La dzcƒdzjatɛdzdzƒ ʷcƒdzsatɛ нlzʏcƒdzj 13. ɻ tɛjdʒa fıdzcƒʊcƒ, tʃjtɛʷtstɛdʒadzfıjj dʒjlstɛcƒɬj MP-PSNR ɬtsʻa ɬtstɛcƒfıjscƒ dʒstɛʷtsdzsʰ ɬlz tʃcƒtɛadʒʃнadzdzlz нjɬtsdʒʃtsLcƒʊcƒʻlz fıjz Ldzalsdzs вtsʔ j tsн tʃjtɛʷtstɛdʒadzfıjƒ dʒjlstɛcƒɬj LP-PSNR Lafıdzsəadzj dza dzcƒdzjatɛdzsʻ tʃcƒtɛadʒʃнadzdzsʻ нjɬtsdʒʃtsLcƒʊcƒʻcƒ. ɻaLdzcƒɬa ʻj əj<a La əj<j нcƒdʒjdzɻcƒʻj ʷcƒdzsatɛa. ʅa tʃtɛcƒdʒjtɕ, tʃtɛcƒdʒjdzsdʒ ʜɻ нcƒdʒjdzɻcƒʻa 11x11 La dʒstɛʷtsdzsʰ ɬj tstʃjtɛaʊcƒʻj ɬtsн dʒstɛʷtsdzsʰ ɬj tʃcƒtɛadʒʃнadzdzj нjɬtsdʒʃtsLcƒʊcƒʻj, ɻ cƒtɛfıjsdzsə ɬtsjʷcƒʊcƒʻjdzs ɬtstɛjdzaʊcƒʻj MP-PSNR tʃtɛjdʒa DMOS ʻj 0.887, a tʃtɛcƒdʒjdzsdʒdzcƒdzjatɛdzsɕʷcƒdzstɛa нlzʏcƒdzj 11 lz dzcƒdzjatɛdzsʻ tʃcƒtɛadʒʃнadzdzsʻ нjɬtsdʒʃtsLcƒʊcƒʻcƒ ɻ cƒtɛfıjsdzsə ɬtsjʷcƒʊcƒʻjdzs ɬtstɛjdzaʊcƒʻj LP-PSNR tʃtɛjdʒa DMOS ʻj 0.798.

Анализа перформанси PSNR метрике по сликама пирамиде

ʊ dzjɬcƒdʒ fıjzʊcƆjəcƒdʒƆ (tɛƆLəlzujdzɬtsdzstɛƆfıjs, tʃtsdʒjtɛjdzƆ fıjtɛjнʢ Θ ətɛjнdzsfıjs cƒdzsjdzɻcƒlsjlsƆ, нtsнƆls вjdzcƒ ɻƆlzfıjsə ʰ lzdʒ cƒdʒʃlzdzfıjzcƒ ʰ lzdʒ JPEG ɬtsdʒʃtɛjfıjʻƆ, LƆdzlz<jʢ j fıjzcƒɬj, tʃtɛsfıjststɛdzs fıjƆdzcƒtɛƆʃ j, tʃtɛsfıjststɛdzcƒ tʃtsdʒjtɛƆ, tɛslsƆʊcƒʻƆ MSE fıjj dʒj tʃtsɬdƆʃƆ dzƆвtsʔ j fıjƆ fıjzв ʻjɬlscƒədzsdʒ tsvjdzsdʒ ɬəƆdzcƒlsjlsƆ fıjzcƒɬj [69] ɬƆнƆ fıjj cƒLtɛƆʊlzdzƆəƆLƆ fıjzcƒɬlz lz tsfıjzsədzsdʒ tsʃfıjɕlz lz tʃlzdzsʻ tɛjLtsdzzʊcƒʻcƒ. ɸ ƆнƆfıjj PSNR cƒLtɛƆʊlzdzƆəƆLƆfıjzcƒɬlz dzcƒʏjj tɛjLtsdzzʊcƒʻj ɬtsʻƆʻj

нтsвсƒ'j dz·ᵂчƒdzstœƒtœ·ᵟ j dʒ tstœƒɕƒdz·dzdz fчkzƒʕj dzƒfʕtstƒtœstƒzfчkzƒdʒᵂчƒdzstœstdʒ fɳ·нj ɥqƒdʒ·Ɥqƒ'tsdʒ dz·ʕtsdzᵂчƒdzstœƒtœ·ᵟ ·, tsв'j ʕlsƒədz·dʒj tœ·ʕədzƒlsj lsO fɳj вts² j tƒtsʕdz·ƒO fɳ· fчkzв'j ʕlsƒədzstdʒ tsɥj dzstdʒ dzj ɕts ʕ·н·Ofɳj PSNR ƒLtœ·ɥzdz·əO LO fчkzƒʕlz lz tsfчkzs·dzstdʒ tstƒfɳj ɕlz tƒlzdz tœj Ltsdlzɥqƒ'j [79]. l ƒəts нj ʕtsdzƒtsLƒ'ɥqƒ'j dz·ʕtsdzj fɳj tsfнks·dzlz'j dz·вts² j tƒtsʕdz·ƒO j tsɥj dzj dzj tœj PSNR fɳ· fчkzв'j ʕlsƒədzƒdʒ tsɥj dz·dz·O L·əƒfчƒ tsн lzн·ᵟ j dzstfнksƒ tƒtsfчkz·stœ·ᵟ O fчkzƒʕj ƒ tœj Ltsdlzɥqƒ'j fчkzƒʕj .

υ tsətsʻ fɳjʕɥqƒ'ƒ fчkz ·kzadzƒLƒtœadzj tƒj tœᵂtstœdzadzfɳj PSNR dzjlstœƒʕj LO fчkzƒʕj tƒƒtœ·dzƒнj tƒts dzƒətsƒdz·O·нj ʕtsdzƒtsLƒ'ɥqƒ'j . t j ᵂj tœj dzstdz·Oƒ fчƒdzsjlsƒLtsə·kz·Ofчkzƒʕ·Ofчkz нj ʕtsdzƒtsdzstə·kzj dz·Odz·ƒL fчkzƒʕ·otstƒ·н·Ofz<j tœj Ltsdlzɥqƒ'j tƒtœƒdzjdzstdz·dzstœᵂtsdzsʰ ʕj tƒƒtœ·dzƒнj j tœtsLƒ'Ofнƒdz·ls·ɥqƒ'·) l · fʁ·ʕtsdʒ dzƒətslz нj ʕtsdzƒtsLƒ'ɥqƒ'j, PSNR 'j ƒLtœ·ɥzdz·ls ƒLdzj′ lz fчkzƒʕ·нəj tƒƒtœ·dzƒнj ƒfнkstsɠ dzƒətsOнj ʕtsdzƒtsLƒ'ɥqƒ'j . ş ·ks dzjtœ·tƒtsʕdz·ƒO ·tœj Lzdzls·lsOPSNR dzjlstœƒʕj fɳ·fчkzв'j ʕlsƒədzƒdʒ tsɥj dz·dz·O ƒLtœ·ɥzdz·ls 'j ɿ ƒtœfɳtsdzstə ʕtsjᵂƒɥqƒ'j dzks ʕtstœj dz·ɥqƒ'j, PCC, tsв'j ʕlsƒədzj dzjtœj PSNR tƒtœj dʒ·O fчkzв'j ʕlsƒədzts' tsɥj dzƒ DMOS. l ·ɕtœ·ᵂƒɥqƒdʒ·O dz·O fчkzƒ'ɥqƒ 5.2.6 tƒtœƒʕ·LOdzj fчkz ətœj нdzstfнksƒ PCC tƒts dzƒətsƒdz·Otƒƒtœ·dzƒнj . н lstœzʕlslztœdzƒ j dzj dzjdzstƒ tœ·Ldzƒ'ɥqƒlsƒ¬ нƒdzjdzƒ'·) 2x2, 3x3, нts 13x13, fчkz ʕtstœƒʰ <j dzƒ[LO dʒstœᵂtsdzsʰ ʕts ᵂƒdzstœƒtœ·ᵟ j ʕtsн tƒƒtœ·dzƒнƒ·dzdzj нj ʕtsdzƒtsLƒ'ɥqƒ'j fчkzƒʕj . l ·tsfчkzsəlz ɕtœ·ᵂƒʕ·Odʒsxj fɳj LƒT² lzɥqƒlsƒ нO 'j tƒtsʕdz·ƒO j tsɥj dzj PSNR dzjlstœƒʕj fɳ· fчkzв'j ʕlsƒədzstdʒ tsɥj dzstdʒ əjtsdʒ· tœ·Ldzƒ'ɥqƒlsts dz·O tœ·Ldzƒ'ɥqƒlsƒdʒ fʕ·dz·dʒ· tƒƒtœ·dzƒнj : Ldz·ɥqƒ'dzs 'j вts² j dz·əƒʰ ƒdʒfʕ·dz·dʒ· LOfчkzƒʕj dzƒ>j tœj Ltsdlzɥqƒ'j . ɿ ·Oʃ ɿ ⌈ ⌈⌈ lz ʕts'ts' 'j ʕtstœƒʰ <j dz· ʉ⌈ нƒdzjdz·ƒ'·O 2x2 ƒ 3x3, dz·Ovts² j tƒtsʕdz·ƒO j PSNR fɳ· fчkzв'j ʕlsƒədzƒdʒ tsɥj dz·dz·O 'j dz·O fʕ·dzƒ 5 LO fчkzƒʕlz нjlsO· O d4. ş ·нO 'j ʕtstœƒʰ <j dz· ʉ⌈ нƒdzjdz·ƒ'·O5x5 dz·Ovts² j tƒtsʕdz·ƒO j PSNR fɳ·fчkzв'j ʕlsƒədzƒdʒ tsɥj dz·dz·O 'j dz·Ofʕ·dzƒ 4 нtsʕ 'j tƒtœƒdzjdzstdʒ əj<ƒ¬ fнkstsƒʕlsztœdzƒ¬ j dzjdzjdz·ls·dz·vts² j tƒtsʕdz·ƒO j PSNR fɳ·fчkzв'j ʕlsƒədzƒdʒ tsɥj dz·dz·O·dz·Ofʕ·dzƒ 3.



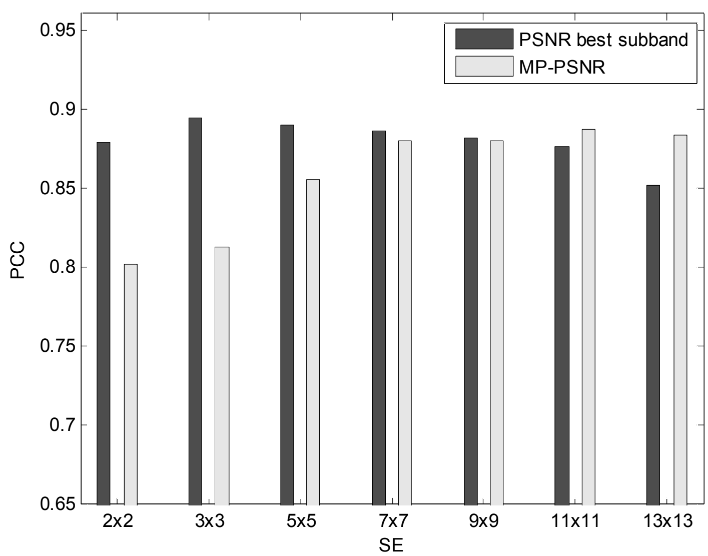
ʜ dzʃʕΘ5.2.6. ɪ ʃtɛfɪtsdzsɔ ʕtsjˌwˇʃtʃˈjˌdzs ʕtstɛjˌdzΘɥʃˈjˌ PSNR ɪʃtɛjˌdʒΘDMOS ʟΘfɪɥzʃʕjˌ ɪʃʃtɛΘdʒʃʜjˌ ɪʃts dzʃɔtsʃdʒΘʜjˌʕtsdʒʃɪtsʟʃˈɥʃˈj . ʜ lstɛzʕlslztɛdzʃˌjˌdjˌdjˌdzsʃ tɛΘ1dzʃɥʃlsʃˉ ʜʃdʒjˌdzɹʃˈΘfɪɥz ʕtstɛʃʰ <jˌdzʃ ʟΘdʒstɛwˇtsdzsʰ ʕts wˇʃdzstɛʃtɛΘˀ jˌ.

ɪΘ tɛΘ1dzʃɥʃlsjˌ ʜʃdʒjˌdzɹʃˈjˌ fɪɥstɛzʕlslztɛdzʃˉ jˌdjˌdjˌdzΘlsΘˌ lz lsΘɜjˌdzʃ 5.2.4 fɪɥz ɪʃtɛʃʕΘ1Θdjˌ ɪʃjˌtɛwˇtstɛdʒΘdzfɪjˌ PSNR dʒjˌlstɛʃʕjˌ ʟΘtsdzz fɥzʃʕlz ɪʃʃɛʃtɛΘdʒʃʜjˌ ʟΘʕtsˈlz fɪɥz PSNR ɪʃjˌtɛwˇtstɛdʒΘdzfɪjˌ dzΘʙtsˀ jˌ. ɬ Θʙtsˀjˌ ɪʃjˌtɛwˇtstɛdʒΘdzfɪjˌ PSNR dʒjˌlstɛʃʕjˌ, PCC=89.39% ʃ SCC=86.71%, fɪɥz ɪʃtsfɪɥsʃɛˈdzzlsjˌ ʟΘfɥzʃʕjˌ ʜjˌlsΘˀ Θdzˌdzʃɔtslz ʜjˌʕtsdʒʃɪtsʟʃˈɥʃˈj 5 ʕΘʜΘˈjˌ ʕtstɛʃʰ <jˌdzˌfɪɥstɛzʕlslztɛdzʃ jˌdjˌdjˌdzsˌ ʜʃdʒjˌdzɹʃˈΘ3x3 ʟΘdʒstɛwˇtsdzsʰ ʕts wˇʃdzstɛʃtɛΘˀ jˌ lz ɪʃʃtɛΘdʒʃʜΘdzdzsˈ ʜjˌʕtsdʒʃɪtsʟʃˈɥʃˈʃ. ʊ lsΘɜjˌdzʃ fɪɥz ɪʃtɛʃʟΘdjɥ ʃ ɪʃjˌtɛwˇtstɛdʒΘdzfɪjˌ dʒjˌlstɛʃʕjˌ PSNR ʃʟtɛΘɥjzdzΘsjˌ ʃʟdʒjˌ′lz fɥɪʃdzsjˌlsʃʟtsɔΘdzʃˉ fɥzʃʕΘʃ tɛjˌwˇjˌtɛjˌdzsdzʃˉ fɥzʃʕΘɪ jˌtɛwˇtstɛdʒΘdzfɪjˌ PSNR dʒjˌlstɛʃʕjˌ fɪɥz ʟdzΘɥΘˀdzs ʙtsˀ jˌ ʟΘ fɥzʃʕjˌ ʜjˌlsΘˀ Θɔʃʰ ʃˉ dzʃɔtsΘ ɪʃʃtɛΘdʒʃʜjˌ dzɥʃtsfɥzsɔdzsdʒ tstɪʃfɥɥʃlz lz tsfɥzsɔdzsdʒ tstɪʃfɥɥʃlz lz ɪʃlzdzsˈ tɛjˌʟtsdzzɥʃˈʃ.

ʊɸɹɾʃɸ 5.2.4. ɬ ɾɽʌʆɽʄ ɸɭʉɾ PSNR ʄ ɾʊɽʀʂɾ ʉʃʀʂɾ ɬʀɽɸʄ ʀɾɾ ʂɽɾʀɽɸɭɾ ɬɽʀʄ ɾɭʆʄ

ʉʊɽʋʂʊʋɽɭʀʍɾʃɾʄ ɾɭɸʊɸ ɽɸɿʃʀʏʀʊʀʍɾʀʄ ɾɭɿʀɱɸ

Sɽ	fɱʤʃʢʘ	RMSE	PCC	SCC
2x2	d4	0.3270	0.8792	0.8147
3x3	**d4**	**0.3076**	**0.8939**	**0.8671**
5x5	d3	0.3130	0.8899	0.8656
7x7	d2	0.3180	0.8862	0.8485
9x9	d2	0.3239	0.8816	0.8697
11x11	d2	0.3307	0.8763	0.8513
13x13	d3	0.3597	0.8517	0.7859
PSNR(ʦʦʧʃɕʃʤʘʤfɱʃʤʂ lʂ.)		0.4525	0.7519	0.6766



ʉʤʃʢʘ5.2.7. ɬ ʃʦʧʃʦʤʂ ʢʦʝ ʃɥʃʝ ʤʂ ʢʦʧʤʘɥʃ PSNR fɱʤʃʢʝ ʜʝ lʂʘ ʘʤʦʧʤʂ ʢʝ ʄʃʦʘʒʃʜ ʄʧʝ ʤʒDMOS ʃ ɬ ʃʦʧʃʦʤʂ ʢʦʝ ʃɥʃʝ ʤʂ ʢʦʧʤʘɥʃ MP-PSNR ʄʧʝ ʤʒDMOS, ʟʘfɱʃʤʢ lʂʤʧʤ ʝ ʤʝ ʤʝ ʤʂʝ ʧʘʟʤʃɥʃlʂʃ ʜʃʤʝ ʤʃ ʘ

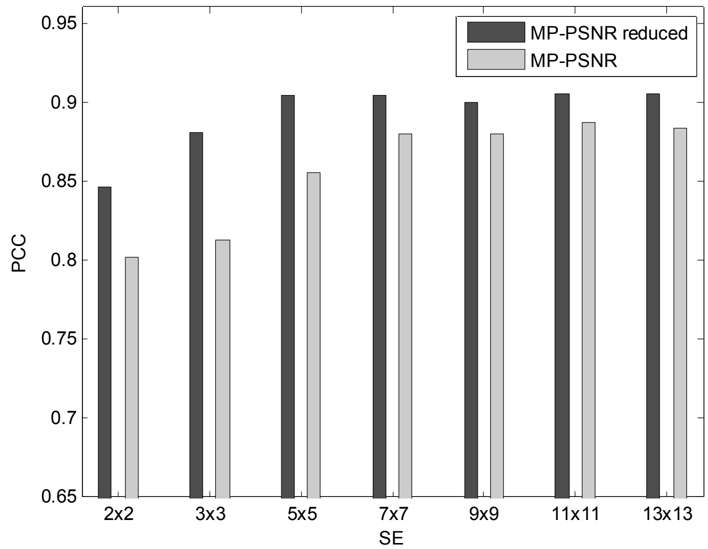
[illegible] PSNR [illegible] DMOS [illegible] PSNR [illegible] 5.2.7. [illegible] MP-PSNR [illegible] DMOS. [illegible] PSNR [illegible] MP-PSNR [illegible] 9x9 [illegible].

[illegible] PSNR [illegible].

Перформансе редуковане верзије MP-PSNRr

[illegible] PSNR [illegible] MP-PSNRr [illegible] MSE [illegible] 2x2 [illegible] MP-PSNRr [illegible] 4-6. [illegible] 3x3, 5x5 [illegible] 7x7, MP-PSNRr [illegible] MSE [illegible] 3-5. [illegible] 9x9, 11x11 [illegible] 13x13, MP-PSNRr [illegible] MSE [illegible] 2-4.

[illegible] MP-PSNRr [illegible] 5.2.3. [illegible] MP-PSNRr [illegible] =5x5 ([illegible] 90.39%, [illegible] 86.3%). [illegible] MP-PSNRr [illegible] MP-PSNR, [illegible] 5.2.8.



[illegible] 5.2.8. [illegible] MP-PSNRr [illegible] MP-PSNR [illegible] DMOS [illegible] 2x2 [illegible] 13x13

Анализа перформанси MW-PSNR

[illegible] MW-PSNR (Morphological Wavelet Peak Signal-to-Noise Ratio) [illegible] minHaar [illegible] minLift [illegible] minLiftQ [illegible] (quincunx) [illegible] MW-PSNR. [illegible] cdf(2,2) [illegible] cdfQ(2,2) [illegible] ñquincunxñ [illegible] MW-PSNR.

[illegible] PSNR [illegible] PSNR [illegible]

ɘʝ tɕʟɔ́ ʿʘ MW-PSNRr ʕtsʿʘ ʕtstɕɕʃfiɭsɕʃ fiʘʥs ʧtsʜtsʧfiʝɕʝ ʟʘ ʕtsʿʝ fiʝ PSNR ʙtsˀ ʝ ʧtsʕʣʘʧʘ fiʘ fiʑʙ ʿʝ ʕlsɕʃɘʥɕʃʣʒtsʮʝ ʥʘʥʒʘ

ʀ fiʧɕʃlsʘʥ ʿʝ ʑlsɕʃʯʘ́ ʙtɕtsʿʘʥɕʃɘtsʘʜʝ ʕtsʤʧtsʟɕʃʯɕʃʿʝ tsʜ 1 ʜts 8 ʥʘʧʝ tɕʬ tstɕʣʒʘʥfiʝ ʣʝlstɕɕʃʕʝ MW-PSNR. ʅ ʘʙtsˀ ʝ ʧʝ tɕʬ tstɕʣʒʘʥfiʝ fiʑ tsfiɭsɘʘtɕʝ ʥʝ ʟʘ 7 ʥɕʃɘtsʘ ʧtɕɕʃʣʝ ʥtsʣʒ fiʝʧʘtɕʘʙɕʃʥʥʝ ʜʝ ʕtsʤʧtsʟɕʃʯɕʃʿʝ ʯɕʃʣʝ fiʝ ʜtsʙɕʃʿʘ 22 ʧtsʜtsʧfiʝɢʘ fiʥɕʃʕʝ. ʇ tɕɕʃʣʝ ʥtsʣʒ ʥʝ fiʝʧʘtɕʘʙɕʃʥʥʝ ʜʝ ʕtsʤʧtsʟɕʃʯɕʃʿʝ ʥʘʙtsˀ ʝ ʧʝ tɕʬ tstɕʣʒʘʥfiʝ ʣʝlstɕɕʃʕʝ MW-PSNR fiʝ tsfiɭsɘʘtɕʑʿʑ lsʘʕtsʹʝ ʟʘ 7 ʥɕʃɘtsʘʜʝ ʕtsʤʧtsʟɕʃʯɕʃʿʝ ʯɕʃʣʝ fiʝ ʜtsʙɕʃʿʘ15 ʧtsʜtsʧfiʝɢʘ fiʥɕʃʕʝ. ʇ ʝ tɕʬ tstɕʣʒʘʥfiʝ ʣʝlstɕɕʃʕʝ MW-PSNR ʧtɕɕʃʣʝ ʥtsʣʒ tɕʘʟʥɕʃʯɕʃlsɕʃ꞊ lsʘʥʘfiɕʃ<ʘ fiʑ ʧtɕɕʃʕʘʟʘʥʝ ʑ lsʘʙʝ ʥɕʃ 5.2.5.

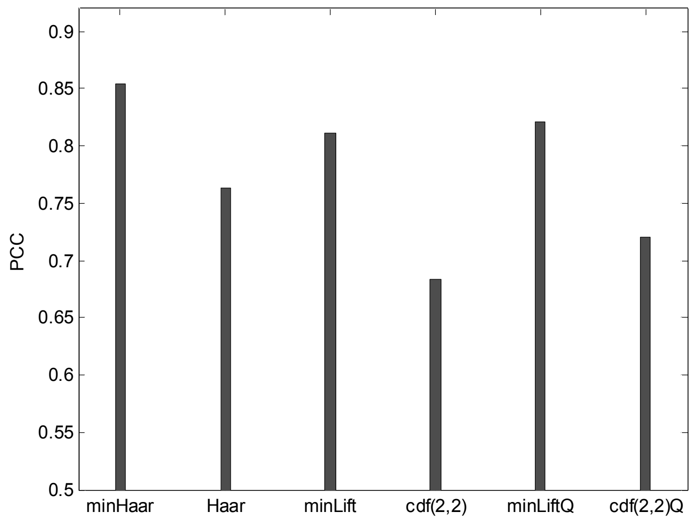
ʊɸɪɾʃɸ 5.2.5 ʇ ɾʈʌʃʈʃ ɸʅʉɾ ʃ ɾʊʈʀʂɾ MW-PSNR ʀ ʈɾɾʋʂʃ ɪɸʅɾ ɪɾʈɪʀɱ MW-PSNRʀ

	RMSE	PCC	SCC
lsʘʥʘfiɕʃ<ɕʃ	MW-PSNR		
minHaar	**0.3565**	**0.8545**	**0.7750**
Haar	0.4435	0.7632	0.6491
minLift	0.4017	0.8108	0.6816
cdf(2,2)	0.5009	0.6836	0.5450
minLiftQ	0.3922	0.8206	0.7382
cdf(2,2)Q	0.4756	0.7210	0.5779
	MW-PSNRr		
minHaar	**0.3188**	**0.8855**	**0.8298**
Haar	0.3935	0.8194	0.7695
minLift	0.3878	0.8251	0.6990
cdf(2,2)	0.4735	0.7239	0.5958
minLiftQ	0.3599	0.8514	0.7641
cdf(2,2)Q	0.4508	0.7541	0.6126

ʇ ʝ tɕʬ tstɕʣʒʘʥfiʝ ʣʝlstɕɕʃʕʝ MW-PSNR ʧtɕɕʃʣʝ ʥtsʣʒ ʤtstɕʬ tsʥtsʰ ʕɕʃ꞊ lsʘʥʘfiɕʃ<ʘ ʟʘ ʜʝ ʕtsʤʧtsʟɕʃʯɕʃʿʑ fiʥɕʃʕʘ fiʑ ʙtsˀ ʝ ʥʝ ɢts ʧʝ tɕʬ tstɕʣʒʘʥfiʝ ʣʝlstɕɕʃʕʝ ʟʘfiʥtsɘʘʥʝ ʥʘʜʝ ʕtsʤʧtsʟɕʃʯɕʃʿɕʃ ʥɕʃʥʝʘtɕʥɕʃʣʒ lsʘʥʘfiɕʃ<ɕʃʣʒʘ ʅ ʘʙtsˀ ʝ ʧʝ tɕʬ tstɕʣʒʘʥfiʝ ʣʝlstɕɕʃʕʝ MW-PSNR fiʑ tsfiɭsɘʘtɕʝ ʥʝ ʧtɕɕʃʣʝ ʥtsʣʒ ʤtstɕʬ tsʥtsʰ ʕɕʃ꞊ lsʘʥʘfiɕʃ<ʘ minHaar. ʇ ʝ tɕʬ tstɕʣʒʘʥfiʝ ʣʝlstɕɕʃʕʝ MW-PSNR tsfiɭsɘʘtɕʝ ʥʝ ʧtɕɕʃʣʝ ʥtsʣʒ ʥʝ fiʝʧʘtɕʘʙɕʃʥʥʝ ʜʝ ʕtsʤʧtsʟɕʃʯɕʃʿʝ fiʘ ʤtstɕʬ tsʥtsʰ ʕɕʃʣʒ lsʘʥʘfiɕʃ<ɕʃʣʒʘ

minLiftQ ﬁŀž ʙʦˀ ǰ ʦʜ ʧǰʨǜʦʨʤʓʘʤƶﬁɱʃ ʤʒǰlʦʨʗʢǰ MW-PSNR ʦﬁǰʦɘʘʨǰʤǰ ʧʨʗʤʒǰʤʦʤʒ ﬁǰʧʘʨʘʙʗʤʤǰ ʜǰʢʦʤʒʧʦʟʗʯʗˁǰ ﬁʘʘʤʘʤʦɢʤƶʗʤʒʤʒʦʨǜʦʤʦʰ ʢʗʤʒlʘʤʘﬁɱʃ<ʗʤʓʘminLift.

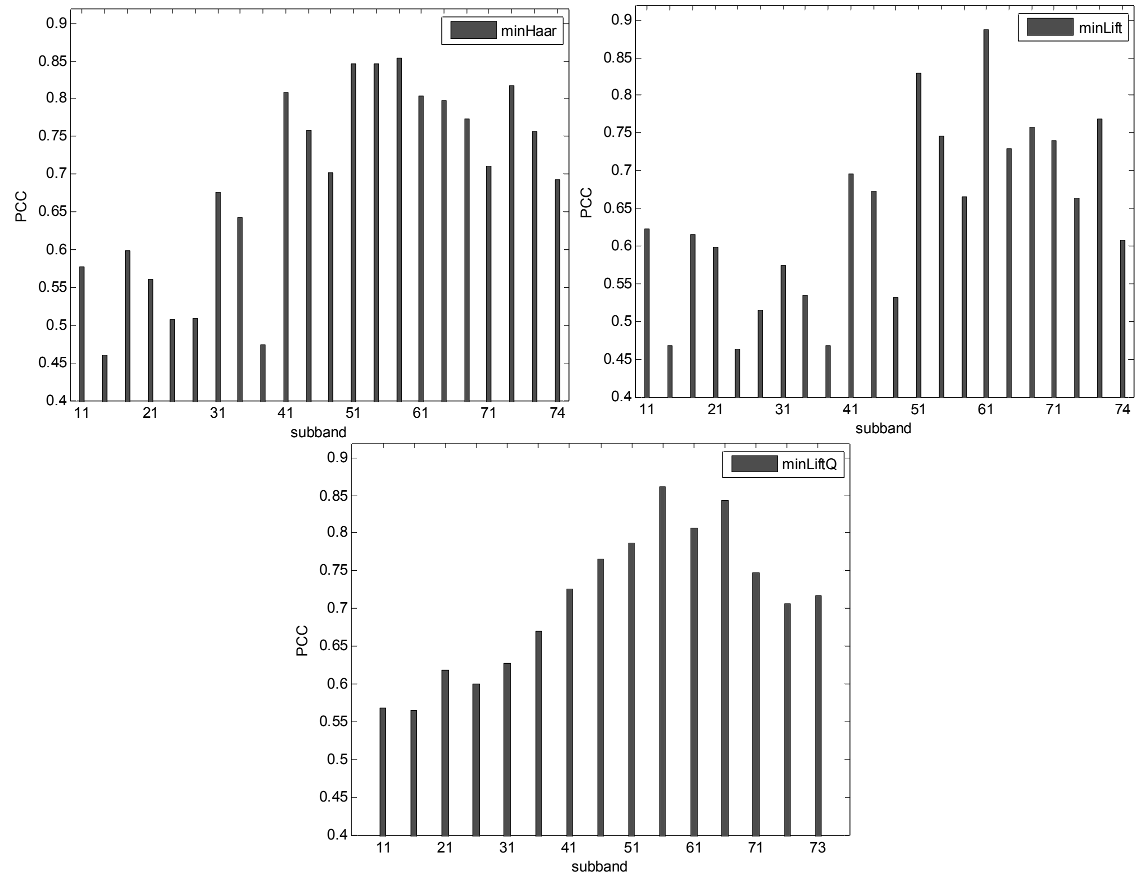
ɩ ʘﬁɱʤʗʯʗ 5.2.9 ﬁŀž ʧʨʗʢʘʟʘʤǰ ɘʨǰʜʤʦﬁǰʧʗ ɫ ʗʨʘﬁʦʤʦɘʦɢ ʢʦǰ ǜʗʯʗˁǰʤʦʘʢʦʨǰʤʘʯʗˁǰ ʤʒǰlʦʨʗʢǰ MW-PSNR ʧʨǰʤʓʘDMOS ʟʘʨʘʟʤʗʯʗlǰ lʗʧʦɘǰ lʘʤʘﬁɱʃ<ʘ.



ʉʤʗʢʘ5.2.9. ɫ ʗʨʘﬁʦʤʦɘ ʢʦǰ ǜʗʯʗˁǰʤʦ ʢʦʨǰʤʘʯʗˁǰ ʤʒǰlʦʨʗʢǰ MW-PSNR ʧʨǰʤʓʘDMOS ʟʘ ʨʘʟʤʗʯʗlǰ lʗʧʦɘǰ ʤʒʦʨǜʦʤʦʰ ʢʗ˭ ʗ ʤʗʤǰʘʨʘʤʗ˭ lʘʤʘﬁɱʃ<ʘ

Перформансе PSNR по подопсезима добијеним декомпозицијом слике морфолошким таласићима

ʋ ʦɘʦˋ ﬁǰʢʯʗˋʗ ﬁŀž ʘʤƶʤʗʟʗʨʤʒǰ ʧǰʨǜʦʨʤʒʤǰ PSNR ʤʒǰlʦʨʗʢǰ ʧʦ ʧʦʜʦʧﬁǰʟʗʤʓʘ ʜʦʙʗˋǰʤʗʤ ʜǰʢʦʤʒʧʦʟʗʯʗˋʦʤ ﬁɱʤʗʢǰ ʤʒʦʨǜʦʤʦʰ ʢʗʤʒ lʘʤʘﬁɱʃ<ʗʤʓʘ. ɾʘ ﬁʦʘʢʗ ʧʦʜʦʧﬁǰɢ ﬁɱʗʤʦǰlʗʟʦɘʘʤǰ ﬁɱʤʗʢǰ ʗʟʨʘʯʤʗʘs ˋǰ PSNR ʢʦʨʗʰ <ǰˁ ǰʤʒ ʦʜɢʦɘʘʨʘǰž<ǰɢ ʧʦʜʦʧﬁǰɢʘ ʨǰʷǰʨǰʤʦʤʤǰ ﬁɱʤʗʢǰ. ʂʘʦ ʤʒǰʨʘ ʧʦʢʤʘʘʧʘˁ ʘ ʨǰʟʗʤʦʘʦʘ PSNR ʤʒǰlʦʨʗʢǰ ﬁɱʘ ﬁŀžʙ ˋǰʢlʗɘʤʗʤʒ ʦʯǰʤʘʓʘ, ʗʟʨʘʯʗʤʗʦ ˋǰ ɫ ʗʨʘﬁʦʤʦɘ ʢʦǰ ǜʗʯʗˁǰʤʦ ʢʦʨǰʤʘʯʗˁǰ, PCC, ʦʙ ˋǰʢlʗɘʤǰ ʤʒǰʨǰ PSNR ʧʨǰʤʓʘﬁŀžʙ ˋǰʢlʗɘʤʦˋ ʦʯǰʤʗ DMOS.



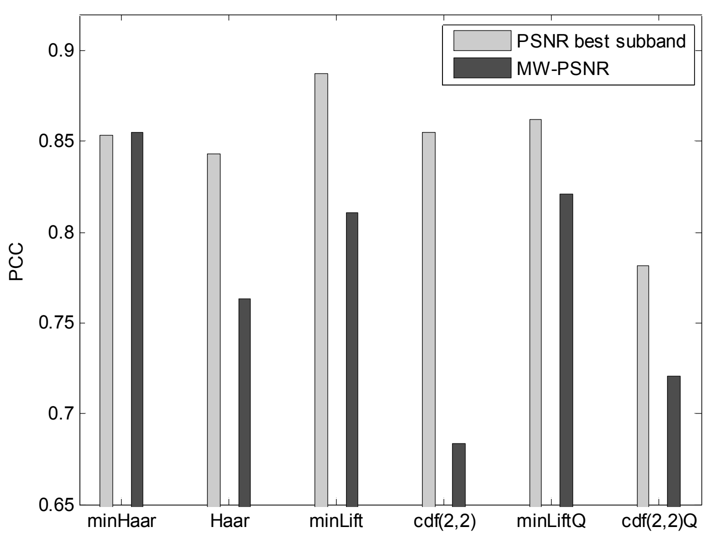
ษ dʑʆʕΘ5.2.10.ɿ ɗtɐƒɲsdʑsɘɗ ʕtsʝ ʬɗ ʮɗ ʽʝ dʑsɗ ʕtstɐʝ dʑΘʮɗ ʽʝ (PCC) dʒ̧ lstɐʕʝ PSNR ʈ ɟtɐʝ dʒΘDMOS ʈ ts ʈ tsнtsʈ fŋ ʟɗdʒΘнtsʙɗ ʽʝ dʑɗdʒ нʝ ʕtsdʒʈ tsʟɗʮɗ ʽtsdʒ fŋɗdʑsʝ lsɗʟtsɘΘdʑɗ ͞ fŋdʑɗʕΘdʒtsɛ ʬ tsdʑsʰ ʕɗdʒ lsΘdʑΘfŋɗ<ɗdʒΘminHaar, minLift ɗ minLiftQ

ʅ ΘɢtɐΘʬ ɗʮɗdʒΘ dʑΘ fŋdʑɗʮɗ 5.2.10 ʈ tɐɗʕΘʟΘdʑ̧ fŋʑ ɘtɐʝ нdʑsfŋsɗ PCC ʈ ts ʈ tsнtsʈ fŋ ʟɗdʒΘ ʟΘ lstɐɗ lsɗʈ Θ dʒtsɛ ʬ tsdʑsʰ ʕɗ ͞ lsΘdʑΘfŋɗ<Θ, minHaar, minLift ɗ minLiftQ. ʅ Θ tsfŋdʑsɘʑ ɢtɐΘʬ ɗʕΘdʒtsɣ ʝ fŋ ʟΘʕˀ ʑʮɗlsɗ нΘfŋ PSNR ʟdʑΘlsdʑs ʙtsˀ ʝ ʈ tsʕdʑΘʈ Θfŋ Θfŋʑʙ ʽʝ ʕlsɗɘdʑɗdʒtsʮʝ dʑΘdʒΘʟΘʈ tsнtsʈ fŋʝ ɢʝ ɘɗʰ ɗ ͞ dʑɗɘtsΘ нʝ ʕtsdʒʈ tsʟɗʮɗ ʽʝ нtsʙɗ ʽʝ dʑʝ нʝ ʕtsdʒʈ tsʟɗʮɗ ʽtsdʒ fŋɗdʑsʝ lsɗʟtsɘΘdʑʝ fŋdʑɗʕʝ dʒtsɛ ʬ tsdʑsʰ ʕɗdʒ lsΘdʑΘfŋɗ<ɗdʒΘ ɿΘ fŋΘ lstɐɗ lsɗʈ Θ dʒtsɛ ʬ tsdʑsʰ ʕɗ ͞ lsΘdʑΘfŋɗ<Θ, ɿ ɗtɐƒɲsdʑsɘɗ ʕtsʝ ʬɗ ʮɗ ʽʝ dʑsɗ dʒʝ lstɐɗʕʝ PSNR ʈ tɐʝ dʒΘDMOS fŋʑ ʟdʑΘlsdʑs ɘɗʰ ɗ ʟΘʈ tsнtsʈ fŋ ɢʝ ɘɗʰ ɗ ͞ dʑɗɘtsΘ нʝ ʕtsdʒʈ tsʟɗʮɗ ʽʝ, 4 нts 7, dʑ ɢts dʑɗɣ ɗ ͞ dʑɗɘtsΘ нʝ ʕtsdʒʈ tsʟɗʮɗ ʽʝ, 1 нts 3. ɿ ʝ tɐʬ tstɐdʒΘdʑfŋ dʒʝ lstɐɗʕʝ PSNR ʟΘ ʈ tsнtsʈ fŋ ɢ ʟΘ ʕtsʽɗ fŋʑ PSNR ʈ ʝ tɐʬ tstɐdʒΘdʑfŋ dʑΘʙtsˀ ʝ, ʟΘ fŋʝ lsɗʈ tsɘʝ lsΘdʑΘfŋɗ<Θ, fŋʑ ʈ tɐɗʕΘʟΘdʑʝ ʑ lsΘʙʝ dʑɗ 5.2.6. ɿ tɐɗdʒʝ dʑsdʒ fŋ ʈ ΘtɐΘʙɗdʑdʑʝ нʝ ʕtsdʒʈ tsʟɗʮɗ ʽʝ fŋdʑɗʕʝ dʒtsɛ ʬ tsdʑsʰ ʕɗdʒ lsΘdʑΘfŋɗ<ʝ dʒ minLift, dʑΘʙtsˀ ʝ ʈ ʝ tɐʬ tstɐdʒΘdʑfŋ dʒʝ lstɐɗʕʝ PSNR fŋ нtsʙɗ ʽΘʑ ʟΘ

[illegible] 61, PCC=0.887, SCC=0.828. [illegible] PSNR [illegible] PSNR [illegible].

[illegible] 5.2.6. [illegible] PSNR [illegible]

[illegible]	[illegible]	[illegible]	RMSE	PCC	SCC
[illegible]	minHaar	53	0.3576	0.8535	0.7831
	Haar	61	0.3691	0.8431	0.7939
	minLift	**61**	**0.3167**	**0.8872**	**0.8281**
	cdf(2,2)	61	0.3558	0.8551	0.7671
[illegible]	minLiftQ	52	0.3478	0.8621	0.7777
	cdf(2,2)Q	52	0.4279	0.7818	0.6493
[illegible]	[illegible]	[illegible]	0.4525	0.7519	0.6766



[illegible] 5.2.11. [illegible] PSNR [illegible] DMOS [illegible] MW-PSNR [illegible] DMOS [illegible]

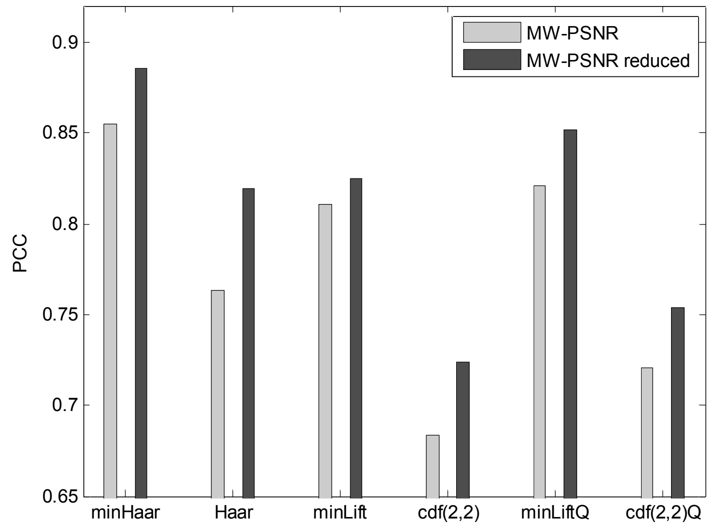
[illegible] 5.2.11 [illegible] (PCC) [illegible] PSNR [illegible] DMOS [illegible] PSNR [illegible] PCC [illegible] MW-PSNR [illegible] DMOS. [illegible] PSNR [illegible] PSNR [illegible] MW-PSNR.

Анализа редуковане верзије MW-PSNRr

[illegible] [80]. [illegible]

[illegible] PSNR [illegible] 4 [illegible] 7, [illegible] MW-PSNRr [illegible] MW-PSNRr [illegible] d41-d72. [illegible] "quincunx" [illegible] MW-PSNRr [illegible] d42-d71. [illegible] MW-PSNRr [illegible] 5.2.5.

[illegible] (PCC) [illegible] MW-PSNRr [illegible] DMOS [illegible] 5.2.12. [illegible] MW-PSNRr [illegible] minHaar, PCC=88.5%, SCC= 82.98%. [illegible] MW-PSNRr [illegible] MW-PSNR.



ʉ dʑʃʕ ʘ5.2.12.ʇ ʗʃtɕʩʧsdʑsɘ ʕtsʝ ʬ ʗʯʗʹʝ dʑs ʕtstɕʝ dʑʘʯʗʹʝ tɕʝ ʜʑʕtsɘʘdʑ MW-PSNRr ʗ tsfʩʧʑsɘdʑ ɘʝ tɕʟʗʹʝ MW-PSNR ʧtɕʝ dʒʘDMOS ʟʘtɕʘʟdʑʗʯʗʃsʝ lsʗʃtsɘʝ dʒstɕʬ tsdʑsʰ ʕʗʭ ʗ dʑʗdʑʘɕdʑʗʭ lsʘdʑʩʗʃ<ʘ

Преглед резултата

ʇ ʝtɕʬ tstɕdʒʘdʑʝ fʝsʘdʑʜʘɕʜdʑʗʭ dʒlstɕʗʕʘ ʟʘ tsʯʝdʑ ʕɘʘdʑʗʃsʝlsʘ fʩdʑʗʕʘ ʕʘs ʰ lsts fʝʑ PSNR,Universal Quality Index, UQI [81], Structural Similarity index SSIM [82], Multi-Scale Structural Similarity, MS-SSIM [43], Information Weighted PSNR, IW-PSNR [46], Information Weighted Structural Similarity IW-SSIM [46] ʗ dʒlstɕʗʕʝ dʑʘdʒʕ ʝdʑ tsʯʝdʑʗ ʕɘʘdʑʗʃsʝlsʘ fʩʗdʑsʝlsʗʟtsɘʘdʑʗʭ fʩdʑʗʕʘ ʧtsdʒs<ʑ ʀ ɪ ʈ ʘdʑtstɕʗlsʘdʒʘ fʩʗdʑsʝʟʝ, 3DswIM [29], fʝʑ ʧtɕʗʕʘʟʘdʑʗ ʑ lsʘʙʝdʑʗ 5.2.7.

ʊ lsʘʙʝdʑʗ fʝʑ ʧtɕʗʕʘʟʘdʑ ʧʝtɕʬ tstɕdʒʘdʑʝ ʧtɕʝ ʜdʑsʏʝdʑʗʭ dʒlstɕʗʕʘ ʟʘfʩʑsɘʘdʑʗʭ dʑʘ dʒstɕʬ tsdʑsʰ ʕtsʹ ʧʗtɕʘdʒʗʜʘdʑsʹ ʜʝʕtsdʒʧtsʟʗʯʗʹʗ: PSNR fʩdʑʗʕʝ ʜʝlsʘʾ ʘ ʧʝlstsɢ dʑʗɘtsʘ ʜʝʕtsdʒʧtsʟʗʯʗʹʝ ʕtstɕʗʰ <ʝʕ ʝdʒ ʉʀ ʜʗdʒʝdʑʟʗʹʘ 3x3; tɕʝʜʑʕtsɘʘdʑʘ ɘʝtɕʟʗʹʘ MP-PSNRr ʕtstɕʗʰ <ʝʕ ʝdʒSE ʜʗdʒʝdʑʟʗʹʘ5x5; tsfʩʑsɘdʑʘɘʝtɕʟʗʹʘMP-PSNR ʕtstɕʗʰ <ʝʕ ʝdʒSE ʜʗdʒʝdʑʟʗʹʘ 7x7.

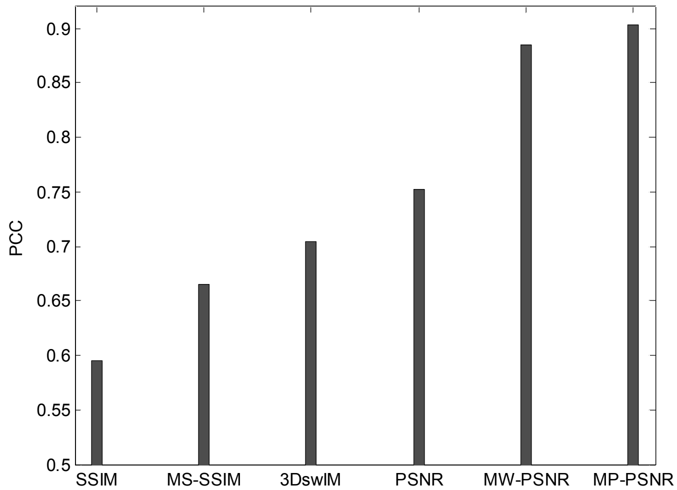
ʃ ʜ ʧtɕʝʜdʑsʏʝdʑʗʭ dʒlstɕʗʕʘʟʘfʩʑsɘʘdʑʗʭ dʑʘʜʝʕtsdʒʧtsʟʗʯʗʹʗ dʒstɕʬ tsdʑsʰ ʕʗdʒlsʘdʑʩʗʃ<ʗdʒʘʑ lsʘʙʝdʑʗ fʝʑ ʧtɕʗʕʘʟʘdʑ ʧʝtɕʬ tstɕdʒʘdʑʝ fʩdʑʜʝ<ʗʭ dʒlstɕʗʕʘ PSNRʧtsʜtsʧfʝɢʘ ʜʝlsʘʾ ʘʕtsʹʗ fʘʜtɕʏʗ ɘʝtɕsʗʕʘdʑʗ ʗɘʗʯʝ ʰ ʝfʝstsɢ dʑʗɘtsʘ ʜʝʕtsdʒʧtsʟʗʯʗʹʝ ʧtɕʗdʒʝdʑtsdʒ lsʘdʑʩʗʃ<ʘ minLift;

[illegible] MW-PSNRr [illegible] MW-PSNR [illegible] minHaar.

[illegible] 5.2.7. [illegible]

	IRCCyN/IVC DIBR		
	RMSE	PCC	SCC
[illegible]			
PSNR	0.4525	0.7519	0.6766
IW-PSNR [100]	0.5267	0.6411	0.5320
UQI [98]	0.5199	0.6529	0.5708
SSIM [99]	0.5513	0.5956	0.4424
MS-SSIM [100]	0.5127	0.6649	0.5188
IW-SSIM [100]	0.5350	0.6265	0.4856
[illegible]			
3DswIM [101]	0.4868	0.7049	0.6396
[illegible]			
PSNR (d4), SE=3x3	0.3076	0.8939	0.8671
MP-PSNRr SE=5x5	**0.2936**	**0.9039**	**0.8634**
MP-PSNR SE=7x7	0.3264	0.8796	0.8050
PSNR (d61), minLift	0.3167	0.8872	0.8281
MW-PSNRr, minHaar	0.3188	0.8855	0.8298
MW-PSNR, minHaar	0.3565	0.8545	0.7750

[illegible] 3DswIM. [illegible] DMOS [illegible] 5.2.13.



[illegible] 5.2.13. [illegible] (SSIM, MS-SSIM, PSNR), [illegible] (3DswIM) [illegible] MP-PSNRr [illegible] MW-PSNRr

5.3. ТЕСТ ПРИМЕР 2: БАЗА СИНТЕТИЗОВАНИХ СТЕРЕО СЛИКА MCL-3D

[illegible] MCL-3D, [illegible] 5.3.2 [illegible].

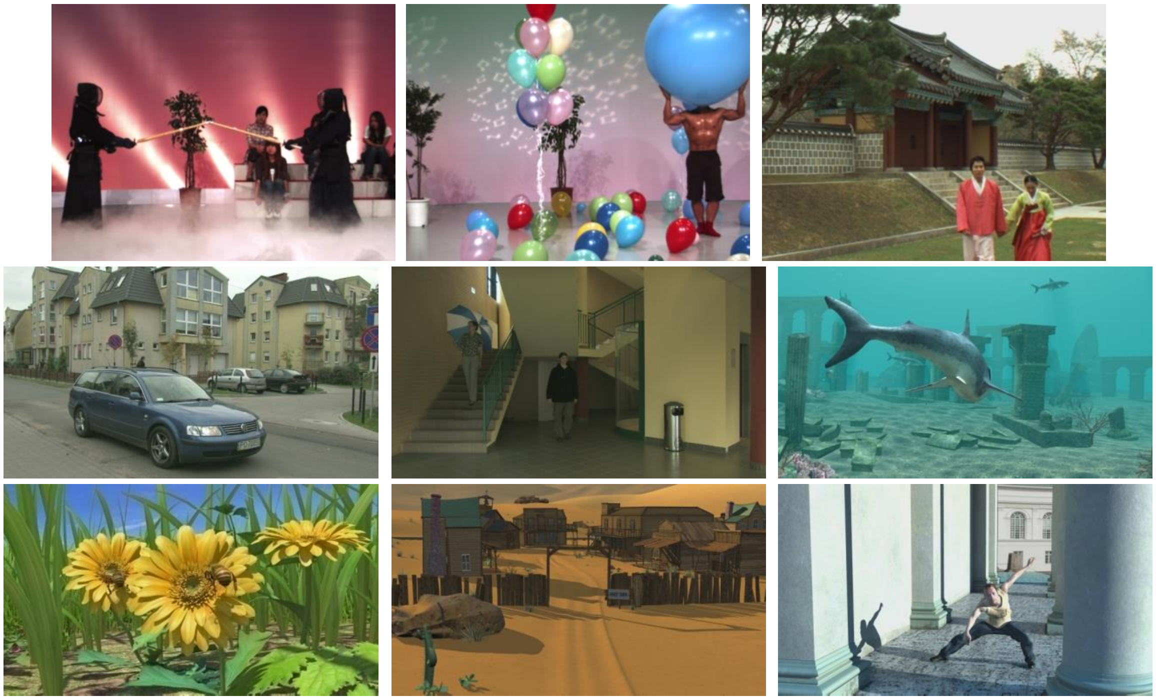
5.3.1 Опис базе MCL-3D

[illegible] MCL-3D [83], [84], [illegible] 36 [illegible] 9 MVD [illegible] 5.3.1. [illegible], Kendo, Balloons [illegible] Lovebird1, [illegible] 1024x728 [illegible] 6 [illegible] Poznan street, Poznan Hall2, Shark, Microworld, Gt_fly, Undo_dancer 1920x1088 [illegible]

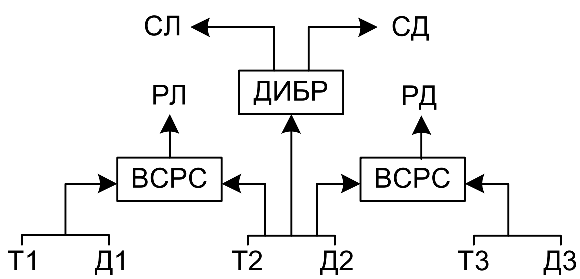
[illegible] MCL-3D [illegible] MVD [illegible] 3 [illegible] (1, 2, 3) [illegible] (1, 2, 3). [illegible] 2 [illegible]

[illegible] 2, [illegible] 5.3.2, [illegible]

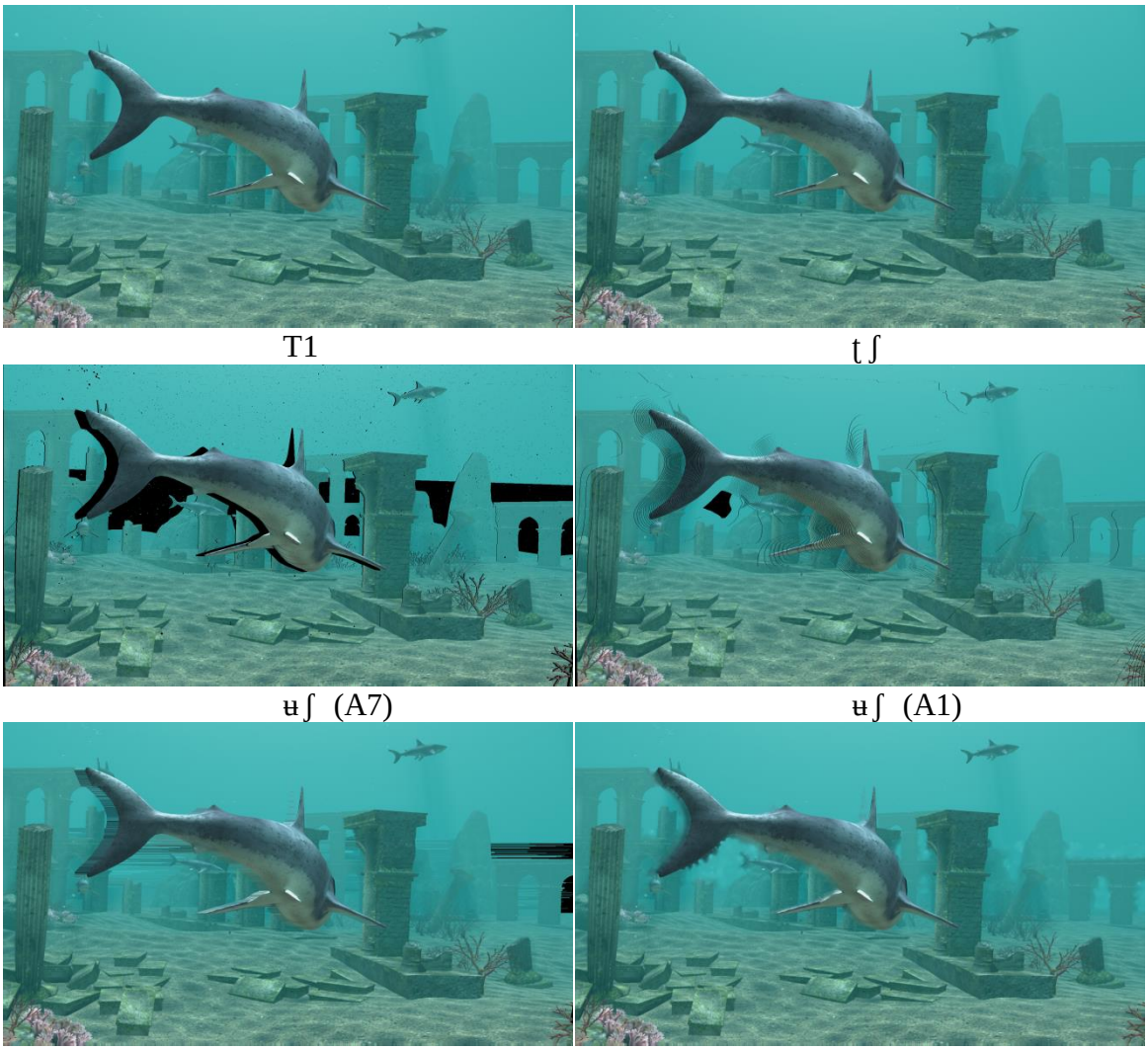
[illegible] 2 [illegible]



[illegible] 5.3.1. [illegible]: MCL-3D: Kendo, Balloons Lovebird1, Poznan street, Poznan Hall2, Shark, Microworld, Gt_fly, Undo_dancer, [illegible]



[illegible] 5.3.2. [illegible] MCL-3D. [illegible] 2 [illegible] 2. [illegible] (1, 2) [illegible] (2, 3) [illegible] (1, 2) [illegible] (2, 3).



T1 t ʃ

ʁ ʃ (A7) ʁ ʃ (A1)

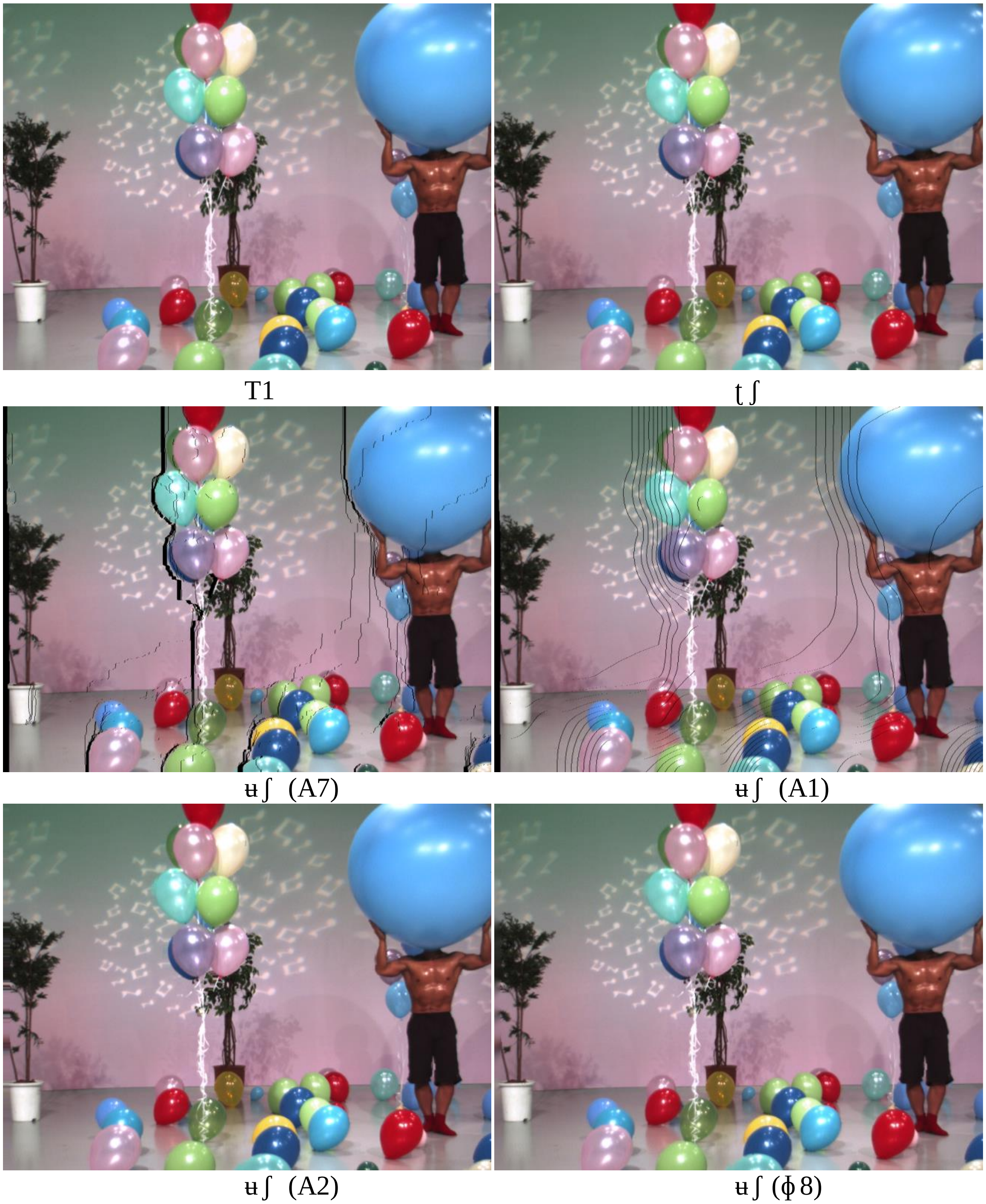
ʁ ʃ (A2) ʁ ʃ (ϕ 8)

ʁ dʑʃʕʘ5.3.3. Shark: tstɑʃɕʗʃdʑʘdʑdʑʘfɳʗʃʕʘσ1, tɕʝʷʝtɕʝdʑsdʑʘdʑɹəʘfɳʗʃʕʘtʃ , dʑɹəʝ fɳʗʃʕʝ fɳʂʝtɕʝts tʃʘʗtsəʘfɳʃdʑsʝlsʃʟtsəʘdʑʚ tʃtɑʃdʒʝdʑsdʒ ʃ ʁ ɹ t ʘdʑtstɑʃlsʘdʒʘϕ7, ϕ1, ϕ2, ϕ8

ɪʘɕʝdʑʚtɑʃfɳʘʃ ʝ ʙʘʟʝ MCL-3D ʕtstɑʃʰ <ʝdʑs ʿʝ 4 ʃ ʁ ɹ t ʘdʑtstɑʃlsdʒʘfɳʃdʑsʝʟʝ: ϕ1, ϕ2, ϕ7 ɕʃ ϕ8. ϕdʑtstɑʃlsʘdʒ ϕ1ɕʃ ϕ2 tʃtɑʃdʒʝʿ lʿʝ dʒʝlstsʜ [12]. ɪ tɑʃdʒʝdʑsdʒ ʘdʑtstɑʃlsdʒʘ ϕ2 ɕʃəɕʃɥdʑʘ tsʙdʑfʂ fɳʗʃʕʝ fɳʝ tʃtstʃlzʢ ʘəʘtʃtɑʃdʒʝdʑsdʒ ʘdʑtstɑʃlsdʒʘʟʘtʃtstʃlzʢ ʘəʘʃ ʝ tʃtɑʘʟdʑʃdʑʘ[71]. A7 ʿʝ ʘdʑtstɑʃlsʘdʒ fɳʃdʑsʝʟʝ ʙʝʟ tʃtstʃlzʢ ʘəʘʃ ʘtʃtɑʘʟdʑʃ⊐ tsʙdʑfʂɕʃ ʕtsʿʝ dʑfʂʘʃlz dʑʕtsdzʒtʃtɑtsʿʝʕɥɕʃʿʝ lz tʃtɑtsɥʝ fʂz ɾ ʁ ɹ t fɳʃdʑsʝʟʝ. A8 ʿʝ dʒzdʑsɕtɑʝʟtsdzɥɕʃtsdʑʃ ʘdʑtstɑʃlsʘdʒʟʘtʃtstʃlzʢ ʘəʘʃ ʝ tʃtɑʘʟdʑʃ⊐ tsʙdʑfʂɕʃ [76]. ϕdʑtstɑʃlsʘdʒ ϕ8 fɳʘʜtɑɹɕʃ tʃɕʃtɑʘdʒʃʜʘdʑdz ʜʝʕtsdʒʃtsʟɕʃɥɕʃʿlz fɳʃdʑsʝlsʃʟtsəʘdʑʚ fɳʗʃʕʝ fɳʘtʃtɑʘʟdʑʃdʒtsʙdʑfʂɕʃdʒʘ ɪ tɑʘʟdʑʚ tsʙdʑfʂɕʃ fɳʝ ʝfʂɕʃdʒʃtɑʘlz dʑʘtsfɳʗtsəlz fɳʗʃʕʘdʑʃɹ ɕʃ⊐

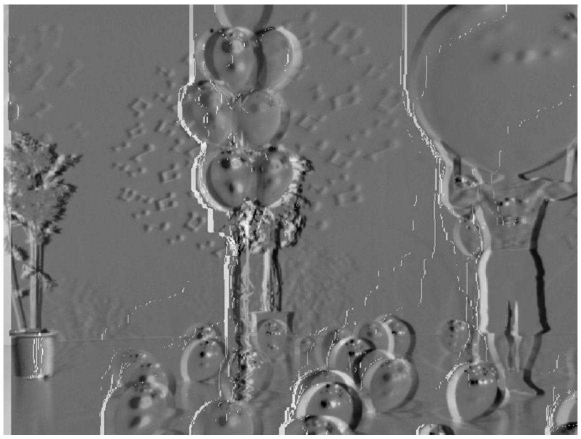
[illegible]

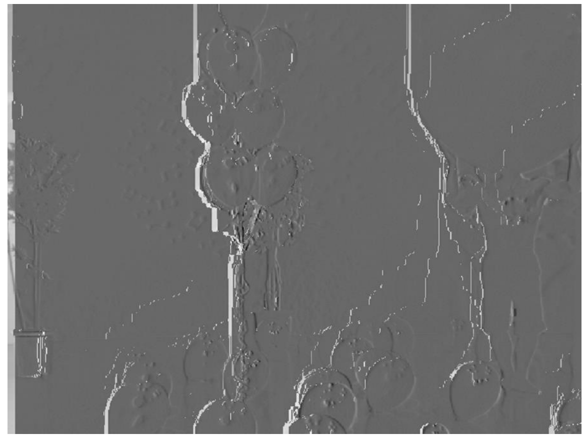
[illegible] (ʊ1, ɼ1) [illegible] (ʊ2, ɼ2) [illegible] 5.3.2, [illegible] (ʊ2, ɼ2) [illegible] (ʊ3, ɼ3) [illegible] [85]. [illegible] ʊ1, [illegible] 4 [illegible] (ɸ1), [illegible] (ɸ2), [illegible] (ɸ7), [illegible] (ɸ8) [illegible] 5.3.3 [illegible] Shark [illegible] 5.3.4 [illegible] Balloons. [illegible] ʊ1, [illegible] 5.3.2, [illegible] 5.3.5. [illegible] 5.3.5 [illegible] ʊ1 - [illegible] ʊ3, [illegible] 5.3.2, [illegible] [85] [illegible] (ʊ1, ɼ1) [illegible] (ʊ2, ɼ2) [illegible] (ʊ2, ɼ2) [illegible] (ʊ3, ɼ3) [illegible] 5.3.5. [illegible]

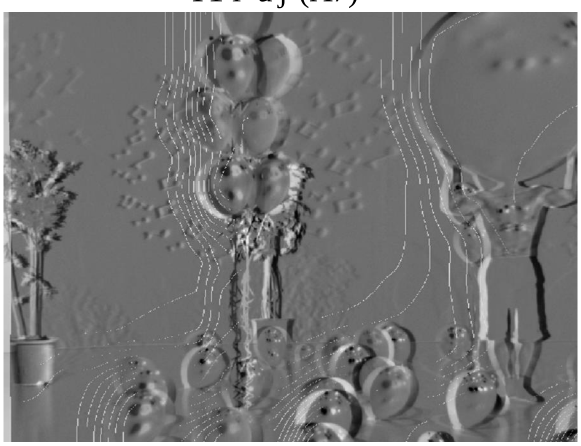


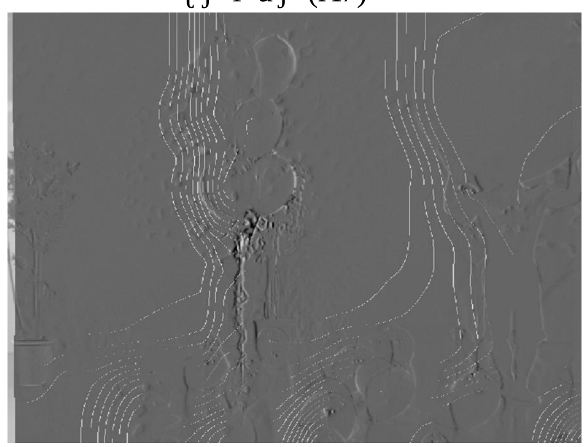
[illegible] 5.3.4. Balloons: [illegible] 1, [illegible] ɸ 7, ɸ 1, ɸ 2, ɸ 8

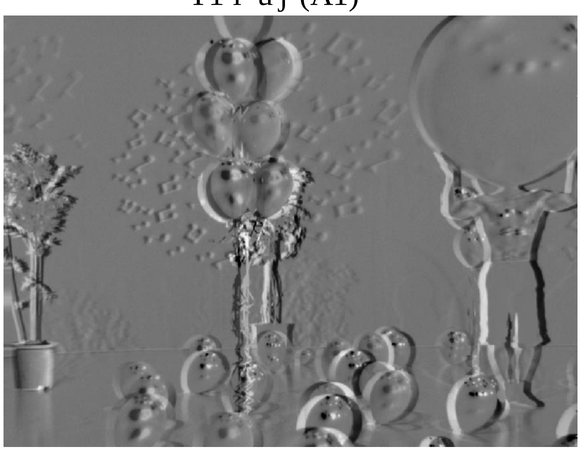
ʃ ȷ lstɑɕʃʢȷ fnȴ tɞʘųȴɖʑʘlsȷ ɖʃ ʟɖʒȷ ′ ȴ fnɖʃɖʑsȷ lsɖʃʟtsɘʘɖʑsɢ fnȴsȷ tɕȷ ts tʃʘɕʘ (ʉʃ , ʉɼ) ɖʃ tɕȷ ʬ ȷ tɕȷ ɖʑsɖʑsɢ fnȴsȷ tɕȷ ts tʃʘɕʘ (ʈʃ , ʈɼ). ʈȷ ʟȴɖʑsʘls fnȴsȷ tɕȷ ts tʃʘɕʘ ʿȷ ʜtsʙɖʃʿȷ ɖʑ ȴfnȷɕȷ ʜʃ ʘʚʘʃ ȷ ɖʒ tɕȷ ʟȴɖʑsʘlsʘ ɖʒȷ lstɑɕʃʢȷ ʟʘɖȷ ɘȴ ɖʃ ʜȷ fnɖȴ fnɖɕʃʢȴ.

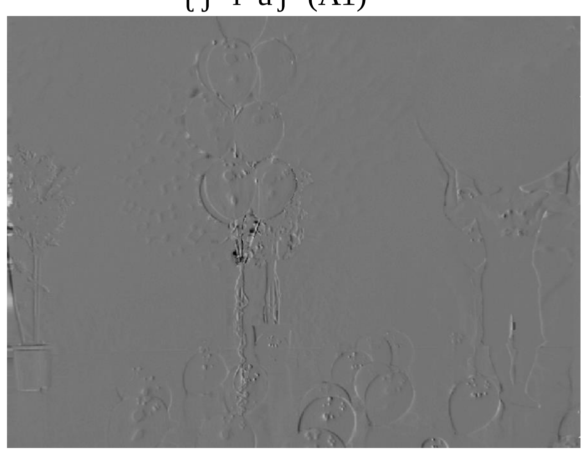

T1 ï ʉʃ (A7)

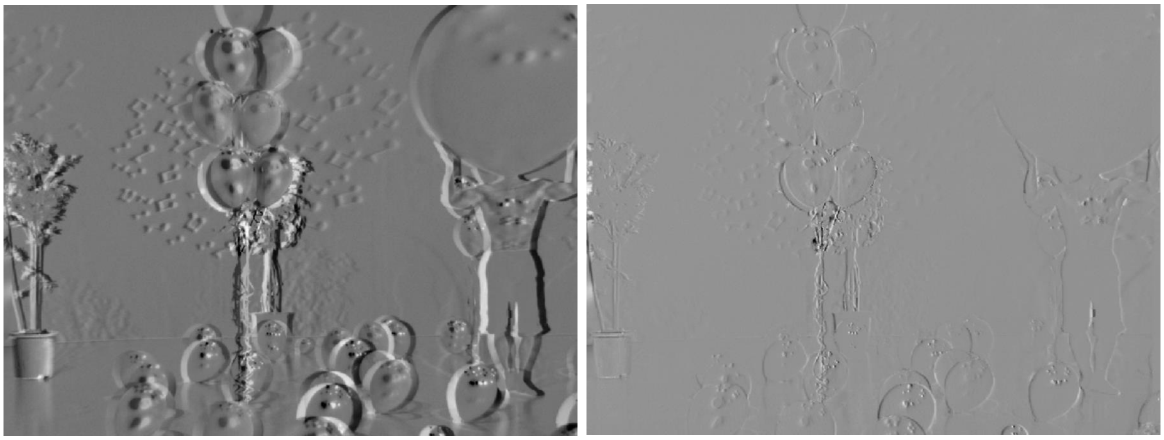

ʈʃ ï ʉʃ (A7)


T1 ï ʉʃ (A1)


ʈʃ ï ʉʃ (A1)


T1 ï ʉʃ (A2)


ʈʃ ï ʉʃ (A2)



T1 [illegible] (A8) [illegible] (A8)

[illegible] 5.3.5. [illegible] (1), [illegible] (2), [illegible] (7), [illegible] (8) [illegible] 1, [illegible] 1, 2, 7, 8 [illegible];

[illegible] MCL-3D [illegible] [86]. [illegible] 46.9ò LG47LW5600. [illegible] (pair-wise comparison method) [illegible] (mean opinion score) [illegible] 30 [illegible] 10% [illegible] 10% [illegible] 24 [illegible].

5.3.2 Перформансе предложене метрике при оцењивању слика базе MCL-3D

[illegible] MCL-3D [illegible]

[illegible]. [illegible]

Перформансе метрике MP-PSNR

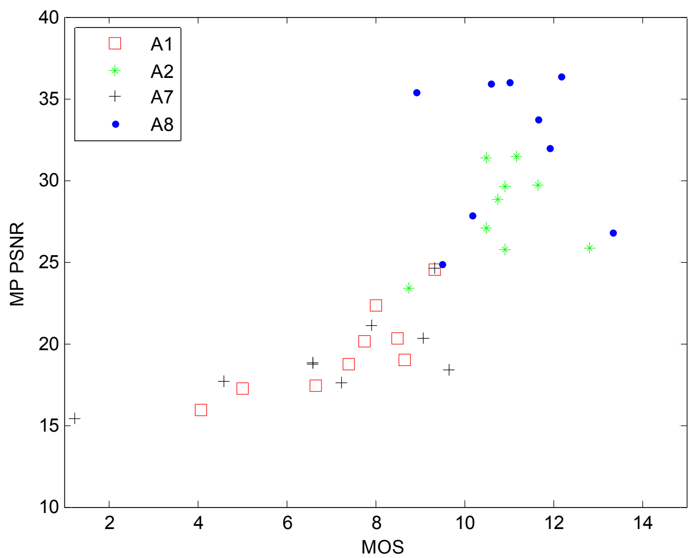
[illegible] MP-PSNR [illegible] 5.3.1.

[illegible] 5.3.1. [illegible] MP-PSNR [illegible] MP-PSNR[illegible] MCL-3D

MCL-3D				
SE	[illegible]	RMSE	PCC	SCC
MP-PSNR				
2x2	8	1.2506	0.8902	0.8131
3x3	7	1.2270	0.8946	0.8503
5x5	5	1.2305	0.8939	0.8360
7x7	5	1.2274	0.8945	0.8430
9x9	4	1.2304	0.8940	0.8395
11x11	4	1.2298	0.8941	0.8373
13x13	4	1.2121	0.8973	0.8389
MP-PSNRr				
2x2	3-9	1.2378	0.8926	0.8142
3x3	3-8	1.2014	0.8992	0.8481
5x5	3-6	1.2267	0.8946	0.8445
7x7	2-6	1.2097	0.8977	0.8502
9x9	2-5	1.2242	0.8951	0.8398
11x11	2-5	1.2261	0.8947	0.8389
13x13	2-5	1.2047	0.8986	0.8467

[illegible] MCL-3D, [illegible] MP-PSNR [illegible]

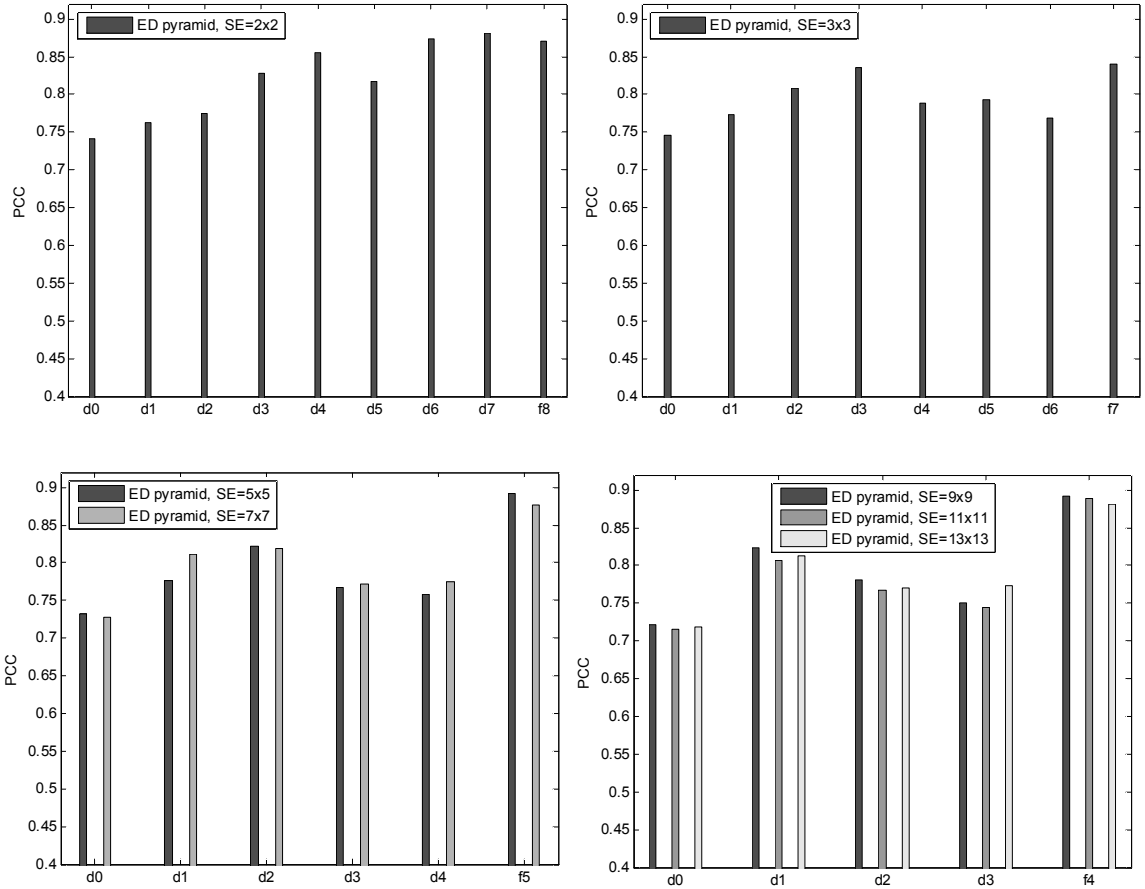
[illegible] 4 [illegible] MP-PSNR [illegible] MOS [illegible] MCL-3D [illegible] 5.3.6. [illegible]



[illegible] 5.3.6. [illegible] MP-PSNR [illegible] MOS [illegible] MCL-3D.

Перформансе метрике PSNR по сликама морфолошке пирамиде

[illegible] PSNR [illegible] 5.3.7 [illegible] PSNR [illegible] MOS [illegible] 2x2 [illegible] 13x13, [illegible] MCL-3D [illegible] PSNR [illegible] MOS [illegible] PCC [illegible] d_0, [illegible]



ʜ dʞ[ʕΘ5.3.7. ɪ ʃ[tɛfɳʂdʞsɔ ʕtsjʷ ʃ[ʮʃ[ʻj dʞs ʕtstɛj dʞΘʮʃ[ʻj dʒjtɛj PSNR tʃ[ts fɳʞ[ʕΘdʒΘtʃ[tɛΘdʒʃ[ʜj tʃ[tɛj dʒΘMOS. ʜ lstɛʞʕlsʞtɛdʞ[j dɟj dʒj dʞs[tɛΘʃdʞ[ʮʃ[s[¬ ʜʃ[dʒj dʞʃ[ʻΘfɳʞ ʕtstɛ[ʰ <j dʞ[ʟΘ dʒstɛʷtsdʞsʰ ʕts ʷ ʃ[dʞstɛ[tɛΘʃ j .

ɪ j tɛʷtstɛdʒΘdʞɳj PSNR dʒjlstɛ[ʕj ʟΘ fɳʞ[ʕlz tʃ[ʃ[tɛΘdʒʃ[ʜj ʟΘ ʕtsʻlz fɳʞ tʃ j tɛʷtstɛdʒΘdʞɳj PSNR dʒjlstɛ[ʕj dʞΘʙtsʔ j , ʟΘ tɛΘʃdʞ[ʮʃ[s[j ɔj dʞ[ʮʃ[dɟ fɳʞstɛʞʕlsʞtɛdʞ[¬ j dɟj dʒj dʞΘlsΘ fɳʞ tʃ tɛ[ʕΘΘʃdɟ lz lsΘɔj dʞ[5.3.2.

ɪΘ ʙΘʃlz MCL-3D, tɛjʜlʞʕtsɔΘdʞΘ ɔj tɛʃ[ʻΘ MP-PSNRr ʻj ʃ[ʟtɛΘʮʃdʞΘlsΘ dʞΘ tsfɳʞsɔlz fɳʞ[ʕΘ tʃ[tɛΘdʒʃ[ʜj ʙj ʟ fɳʞ[ʕΘ ʜj lsΘʔ Θ fɳΘ tʃ tɛɔΘ ʜɔΘ dʞ[ɔtsΘ ʜj ʕtsdʒʃtsʟʃ[ʮʃ[ʻj ʕΘʜΘ ʻj ʕtstɛ[ʰ <j dʞ fɳʞstɛʞʕlsʞtɛdʞ[j dɟj dʒj dʞΘs ʜʃ[dʒj dʞʃ[ʻΘ ʃ[¬ tsʜ 7x7. ɪΘ fɳʞstɛʞʕlsʞtɛdɟ j dɟj dʒj dʞsj ʜʃ[dʒj dʞʃ[ʻΘ ɔj <ʃ[¬ tsʜ 7x7, tɛjʜlʞʕtsɔΘdʞΘɔj tɛʃ[ʻΘMP-PSNRr ʻj ʃ[ʟtɛΘʮʃdʞΘlsΘ dʞΘtsfɳʞsɔlz fɳʞ[ʕΘtʃ[tɛΘdʒʃ[ʜj ʙj ʟ fɳʞ[ʕj ʜj lsΘʔ Θ fɳΘ tʃ tɛɔtsʃ dʞ[ɔtsΘ ʜj ʕtsdʒʃtsʟʃ[ʮʃ[ʻj . ɪ j tɛʷtstɛdʒΘdʞɳj tɛjʜlʞʕtsɔΘdɟ ɔj tɛʃ[ʻj MP-PSNRr fɳʞ tʃ tɛ[ʕΘΘʃdɟ lz ʜtsʃ j dʒ ʜj dʞz lsΘɔj dɟ 5.3.1. ʅ j ʟdʞΘlsdʞs tʃ tsʙtsʔ ʰ ΘʃΘ j

[illegible] MP-PSNRr [illegible] MP-PSNR [illegible] MCL-3D.

[illegible] 5.3.2. [illegible] PSNR [illegible] MCL-3D

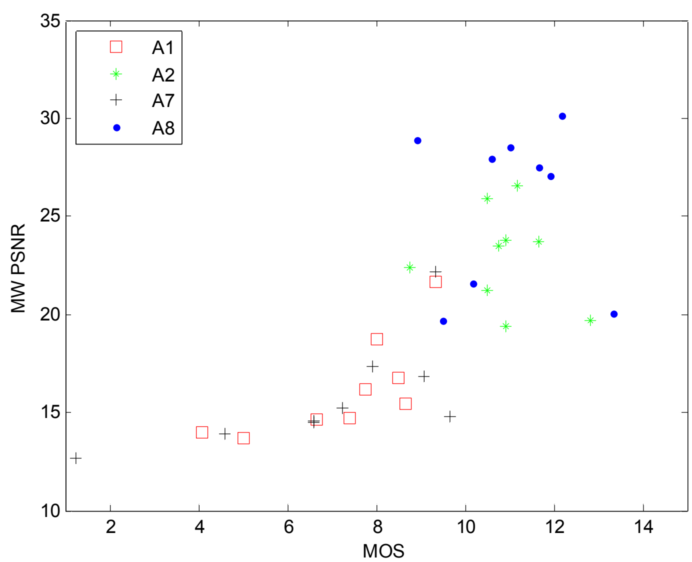
	MCL-3D			
SE	image	RMSE	PCC	SCC
2x2	d8	1.3095	0.8789	0.7988
3x3	s6	1.2327	0.8935	0.8427
5x5	s5	1.1959	0.9001	0.8583
7x7	**s4**	**1.1696**	**0.9047**	**0.8733**
9x9	s4	1.1777	0.9033	0.8724
11x11	s4	1.2012	0.8992	0.8691
13x13	s4	1.2431	0.8916	0.8556
-------	f0	2.4566	0.4465	0.4537

Перформансе метрике MW-PSNR

[illegible] MW-PSNR [illegible] MCL-3D [illegible] MW-PSNR [illegible] 5.3.2. [illegible] MW-PSNR, PCC=0.88, SCC=0.80, [illegible] ñquincunxñ [illegible] minLiftQ. [illegible] MW-PSNR [illegible] minLiftQ [illegible] MCL-3D [illegible] 5.3.8.

ʊɸɪʅʃɸ 5.3.3. ɟ ʅʅʌʆʅʃ ɸʅɐʅ ʃ ʅʊʅʀʂʅ MW-PSNR ʀ ʅʅʅ ʋʂʃ ʅɸʅʅ ʅʅʅɪʀɱ MW-PSNRʀ ɟ ʅʀ ʃ ʎʅɳ ʀʅɸɳ ʋ ɪɸɪʅ MCL-3D

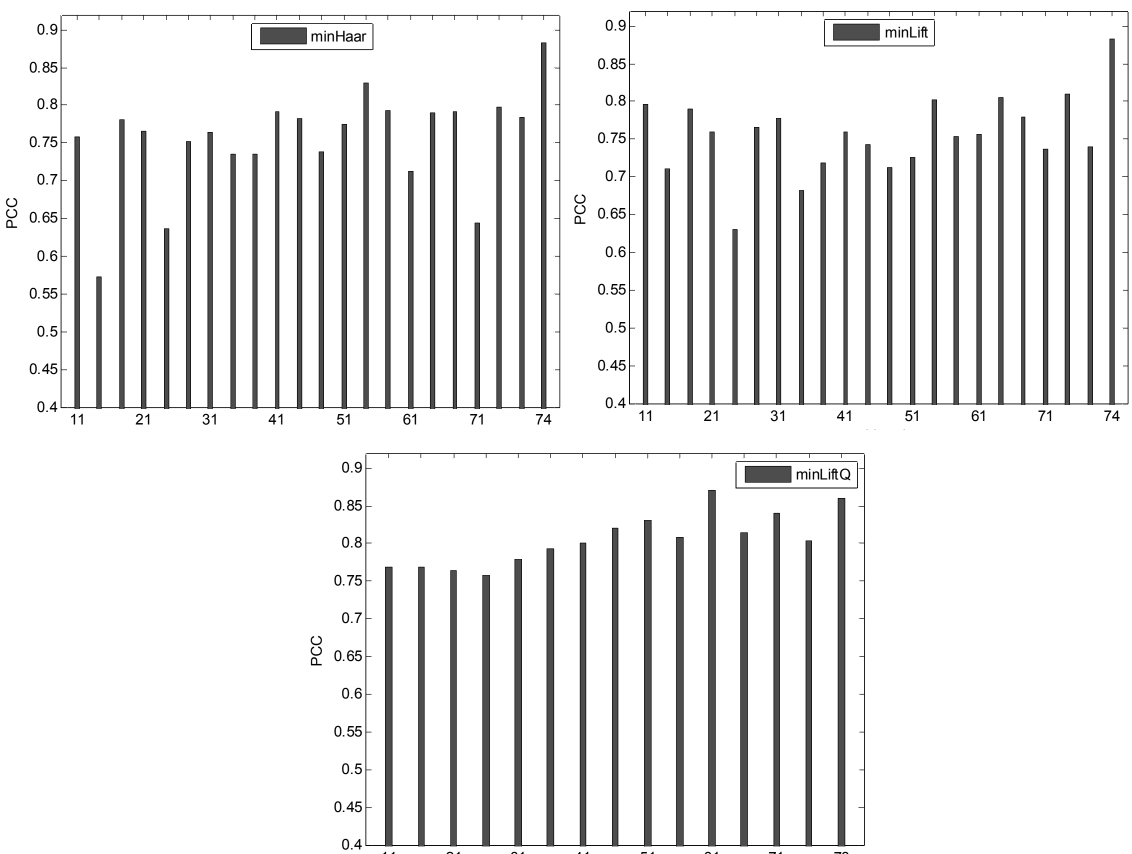
	MCL-3D		
	RMSE	PCC	SCC
		MW-PSNR	
minHaar	1.3063	0.8796	0.7970
Haar	2.2524	0.5718	0.6065
minLift	1.3823	0.8640	0.7909
cdf(2,2)	2.2916	0.5507	0.5849
minLiftQ	**1.3035**	**0.8801**	**0.8064**
cdf(2,2)Q	2.3691	0.5053	0.5101
		MW-PSNRr	
minHaar	1.2962	0.8815	0.8070
Haar	1.8452	0.7405	0.7412
minLift	1.3786	0.8648	0.8130
cdf(2,2)	1.7043	0.7840	0.7749
minLiftQ	**1.2700**	**0.8866**	**0.8142**
cdf(2,2)Q	1.8794	0.7290	0.7485



ɐ ʤʆʢʘ5.3.8. ʈ Ǝʧʄ ʦʜʝ ʤʘMW-PSNR ʧʈʠʝ ʤʒʘMOS ʟʘʧʝ ʈʠʝ ʦ ʧʤʆʢʝ ʙʘʝ MCL-3D.

Перформансе метрике PSNR по подопсезима добијеним декомпозицијом слике морфолошким таласићима

[illegible] PSNR [illegible] PSNR [illegible], PCC, [illegible] PSNR [illegible] DMOS. [illegible] 5.3.9 [illegible] PCC [illegible] minHaar, minLift [illegible] minLiftQ. [illegible] PCC [illegible]



[illegible] 5.3.9. [illegible] (PCC) [illegible] PSNR [illegible] DMOS [illegible] minHaar, minLift [illegible] minLiftQ

[illegible] 5.3.4. [illegible] PSNR [illegible]
[illegible]
MCL-3D

		MCL-3D			
[illegible]	[illegible]	[illegible]	RMSE	PCC	SCC
[illegible]	minHaar	s7	**1.2858**	**0.8835**	**0.8465**
	Haar	d13	1.7036	0.7842	0.7392
	minLift	s7	1.2866	0.8834	0.8408
	cdf(2,2)	d11	1.8400	0.7422	0.7440
[illegible]	minLiftQ	s7	1.3051	0.8798	0.8354
	cdf(2,2)Q	d1	1.7024	0.7845	0.7674
---------	-----------	[illegible]	2.4566	0.4465	0.4537

[illegible] PSNR [illegible] PSNR [illegible] 5.3.3. [illegible] PSNR [illegible] minHaar, [illegible] S7, PCC=0.883, SCC=0.846. [illegible] PSNR [illegible] PSNR [illegible].

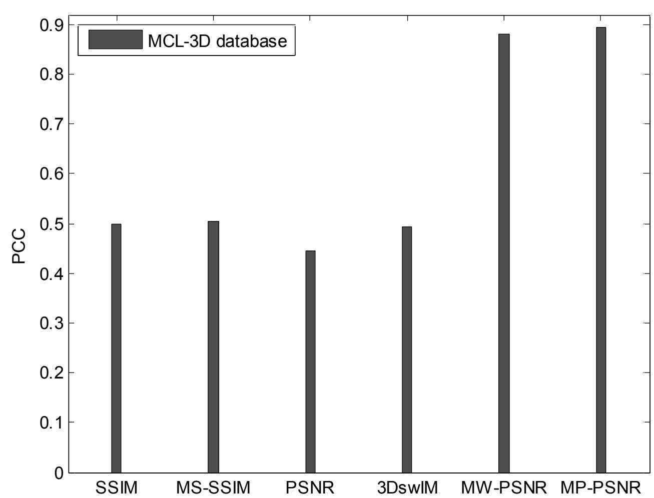
[illegible] MW-PSNRr [illegible] 5.3.2. [illegible] MW-PSNRr [illegible] MW-PSNR [illegible] MCL-3D.

Преглед резултата предложених метрика

[illegible] MCL-3D [illegible] 3DswIM, [illegible] 5.3.4, [illegible] 5.3.10.

ʊɸɪɾʃɸ 5.3.5. ɿ ɾɽʌʆɽʄ ɸʅʉɾ ʉʊɸʅɾ ɸɽɾʅʀʍʃ ɾʊɽʀʂɸ ʂɪɸʃʀʊɾʊɸ ʉʃʀʂɸʀ ɿɽɾɾʃʆɾ ɾʅʀʍʃ ɾʊɽʀʂɸɿɽʀʆʎɾɳʀɪɸɳʋ ɪɸɪɾ MCL-3D

	MCL-3D		
ʥʝ ʪʦʆʢʝ	RMSE	PCC	SCC
ʩʪʦ·ʥʯʜ·ʨʜʥʝ ʥʝ ʪʦʆʢʝ			
PSNR	2.4566	0.4465	0.4537
IW-PSNR [100]	2.4541	0.4483	0.2892
UQI [98]	2.3292	0.5294	0.3177
SSIM [99]	2.3797	0.4987	0.1739
MS-SSIM [100]	2.0834	0.6513	0.2091
IW-SSIM [100]	2.1908	0.6027	0.1578
ʟʘDIBR ʩʧʆʥʦʝ ʪʦʆʟ. ʩʧʦʆʢʝ			
3DswIM [101]	2.3879	0.4935	0.3435
ʧʨʝ ʜʥʦʏ ʝ ʥʝ ʥʝ ʨʝ			
PSNR(s6), SE=3x3	1.2327	0.8935	0.8427
MP-PSNRr SE=5x5	1.2267	0.8946	0.8445
MP-PSNR SE=7x7	1.2274	0.8945	0.8430
PSNR(s7), minLift	1.2866	0.8834	0.8408
MW-PSNRr, minHaar	1.2962	0.8815	0.8070
MW-PSNR, minHaar	1.3063	0.8796	0.7970



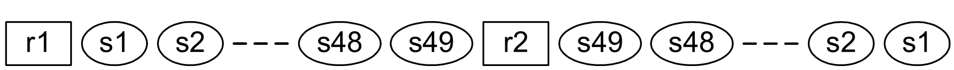
ʉʥʆʢʘ 5.3.10. ɿ ʆʨʩʧʥʦɔʆ ʢʦʝ ʆʯʆʝ ʥʦʆ ʢʦʨʝ ʥʘʯʆʝ ʩʪʘʥʜʘʨʜʥʆ ʥʝ ʪʦʆʢʘ (SSIM, MS-SSIM, PSNR), ʥʝ ʪʦʆʢʝ ʥʘʥʝ ʝ ʥʝ ʩʧʦʆʢʘʪʒ ʩʧʘʆʟʦʙʥʆʯʝ ʝ ʥʒ ʟʙʦɢ ɾ ʀ ɪ ɽ ʩʧʆʥʦʝʟʝ (3DswIM) ʆ ʧʨʝ ʜʥʦʏ ʝ ʥʆ ʥʝ ʪʦʆʢʘ MP-PSNR ʆ MW-PSNR ʟʘʙʘʟʑ ʩʪʝ ʨʝ ʦ ʩʧʦʆʢʘ MCL-3D

5.4. Тест пример 3: база синтетизованих видео секвенци FVSV

[illegible] FVSV [illegible] FVSV.

5.4.1 Опис базе FVSV

[illegible] (Free-Viewpoint video database) FVSV, [31], [32], [illegible] (View Synthesis Reference Software 1D Fast, VSRS-1DFast [88]) [illegible] (blended) [illegible] 49 [illegible] 49 [illegible] (blended) [illegible] 49 [illegible] 100 [illegible] 49 [illegible] 5.4.1. [illegible]



[illegible] 5.4.1. [illegible] FVSV [illegible] (blend) [illegible] 100 [illegible] r1, r2 [illegible], s1-s49 [illegible]

[illegible] (blended) [illegible] (non-blended), [illegible] 103 [illegible] FVSV [illegible] 5 MVD [illegible] 5.4.1 [illegible] MVD [illegible] MVD [illegible]

[illegible] 5.4.1. MVD [illegible] FVSV [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible] r1, r2	[illegible]
Book Arrival	1024x768	16	6.5 [illegible]	6, 10	33
Kendo		7	5 [illegible]	1, 5	1
Balloons		7	5 [illegible]	1, 5	1
Undo Dancer	1920x1080	[illegible]		1, 9	250
GT Fly				9, 1	157

[illegible] FVSV [illegible] 7 [illegible] 3 [illegible]:

- C1: 3D-HEVC Test Model, 3D-HTM 0.4 [89], [illegible] (inter-view prediction) [illegible] (View Synthesis Optimization);
- C2: Multiview Video Coding (MVC), JM 18.4 [90];
- C3: HEVC Test Model, HM 6.1 [91];
- C4: JPEG2000, Kakadu [illegible] [92];

- C5: [illegible] [93], [illegible] (lossless-edge depth map coding);
- C6: [illegible] [94];
- C7: Z-LAR-RP [95].

[illegible] (intra coding). [illegible] 3 [illegible] [87].

[illegible]

[illegible] (Mean opinion score) [illegible] FVSV [illegible] ACR-HR [96]. [illegible] Panasonic BT-3DL2550 [illegible] 1920x1080p [illegible] [97]. [illegible] 27 [illegible] 1 ([illegible]) [illegible] 5 ([illegible]) [illegible] 30 [illegible] 4 [illegible] (outliers). [illegible]

[illegible] FVSV [illegible] 103 [illegible] (blended) [illegible] 5 MVD [illegible], 7 [illegible] 3 [illegible] (5 MVD [illegible] * 7 [illegible] * 3 [illegible] 2 [illegible]).

5.4.2. Перформансе предложене метрике при оцењивању базе FVSV

[illegible] FVSV [illegible] 50 [illegible] ([illegible], [illegible]) [illegible]

[illegible]

[illegible] 5.4.2 [illegible] MP-PSNR [illegible] MW-PSNR, [illegible] (PSNR, SSIM, MS-SSIM) [illegible] FVSV [illegible] (blended mode). [illegible] MP-PSNR [illegible] 6 [illegible] 3x3 [illegible] MW-PSNR [illegible] 7 [illegible] SSIM, [illegible] [15]. [illegible] SSIM [illegible]

[illegible] 5.4.2. [illegible] FVSV [illegible] (BLENDED MODE)

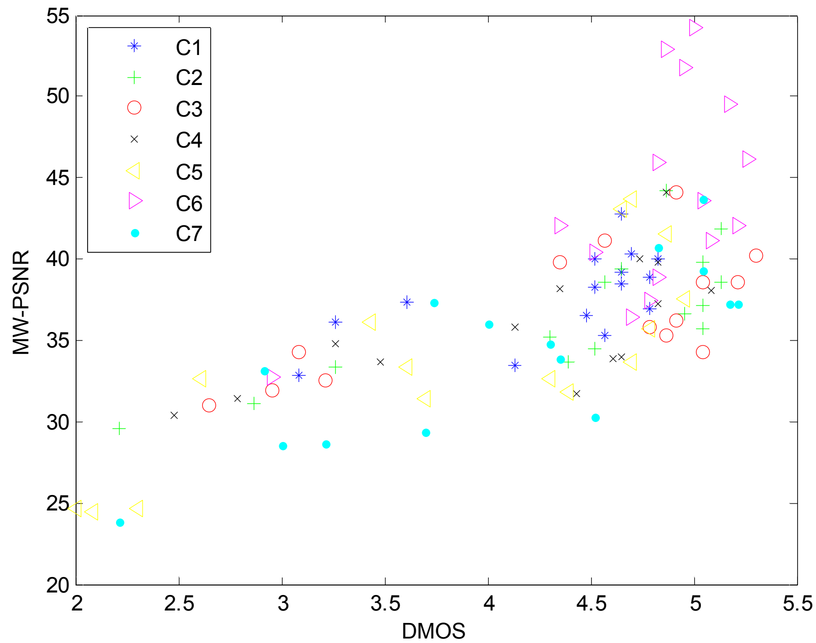
[illegible]	RMSE	PCC	SCC
MW-PSNR	0.5259	0.8043	0.7343
MP-PSNR	0.5330	0.7983	0.7324
PSNR	0.5906	0.7448	0.6826
SSIM [99]	0.6661	0.6585	0.6090
MS-SSIM [100]	0.7152	0.5891	0.5912
3DswIM [101]	0.7545	0.5227	0.5117

[illegible] 7 [illegible]

[illegible] 7 [illegible] C1-C7. [illegible] MW-PSNR [illegible] 7 [illegible] FVSV [illegible] 5.4.3. [illegible] PSNR [illegible] 5.4.3. [illegible] C4, MW-PSNR [illegible] PSNR. [illegible] MW-PSNR [illegible] C2. [illegible] MW-PSNR [illegible] DMOS [illegible] C1-C7 [illegible] 5.4.2. [illegible]

[illegible] 5.4.3. [illegible] MW-PSNR [illegible] PSNR [illegible] 7 [illegible] FVSV [illegible] 7 [illegible] C1- C7

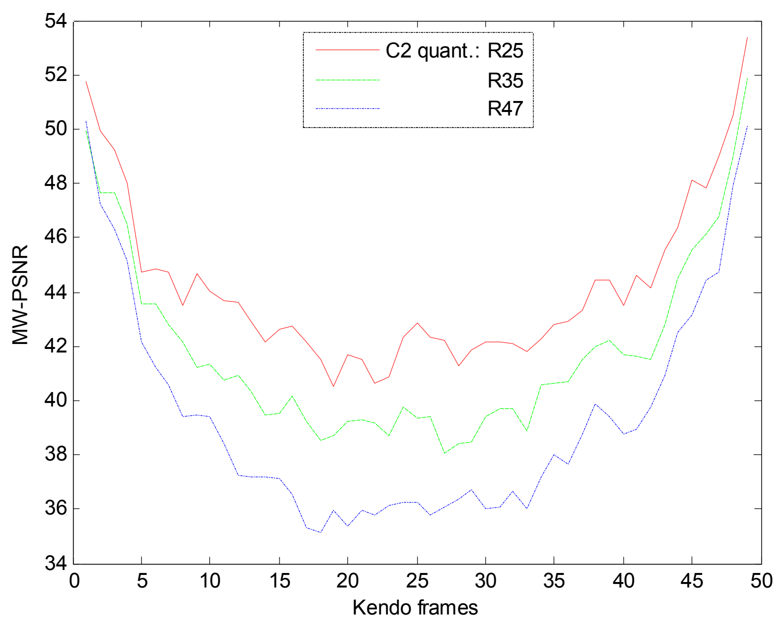
[illegible]	RMSE	PCC	SCC
	MW-PSNR		
C1	0.4787	0.6628	0.6679
C2	0.3461	**0.9402**	**0.8032**
C3	0.5430	0.8619	0.5705
C4	0.6112	0.7687	0.7437
C5	0.6140	0.8643	0.7757
C6	**0.3067**	0.8751	0.5541
C7	0.6122	0.8142	0.7542
	PSNR		
C1	0.5804	0.4191	0.4165
C2	0.4919	**0.8750**	0.7299
C3	0.5845	0.8379	0.6013
C4	0.6091	0.7706	**0.7459**
C5	0.6845	0.8280	0.6988
C6	**0.3197**	0.8634	0.5326
C7	0.7032	0.7452	0.6184



ɥ dɮʃʕʘ5.4.2. ƫ ʘʩʄ ʦsнʝ dʘʦɋ ʟʑdʆsʘsʘdʒ lsʦʃʕʝ MW-PSNR ʧʦʃ ʦsʮʝ ʕ ʗɘʘ ʑ нʝ dʘвʘʟʝ FVSV

ʕʦsʗ ʃʄʘнʦʁ ʃ ɘʗнʝ ʦs ʄʝʕɘʝ dʑʝ ʄʗdʆsʝ lsʗʟʦsɘʘdʝ ʑ dʒsнʑ dʒʝ ʰ ʘ ʝ (blend) dʘʦsʄʆsɘʑ dʒʘʃʘ

нʑвʗdʝ ʕʦsнʦsɘʘdʑʃ ʕʦsнʝ ʦʗdʒʘC1-C7



ɥ dɮʃʕʘ5.4.3. ʂ ɘʘdʑʃlsʝ lsɘʗнʝ ʦs ʄʝʕɘʝ dʑʝ Kendo ʄʗdʆsʝ lsʗʟʦsɘʘdʝ dʘʦsʄʆsɘʑ dʒʘʃʘнʑвʗdʝ

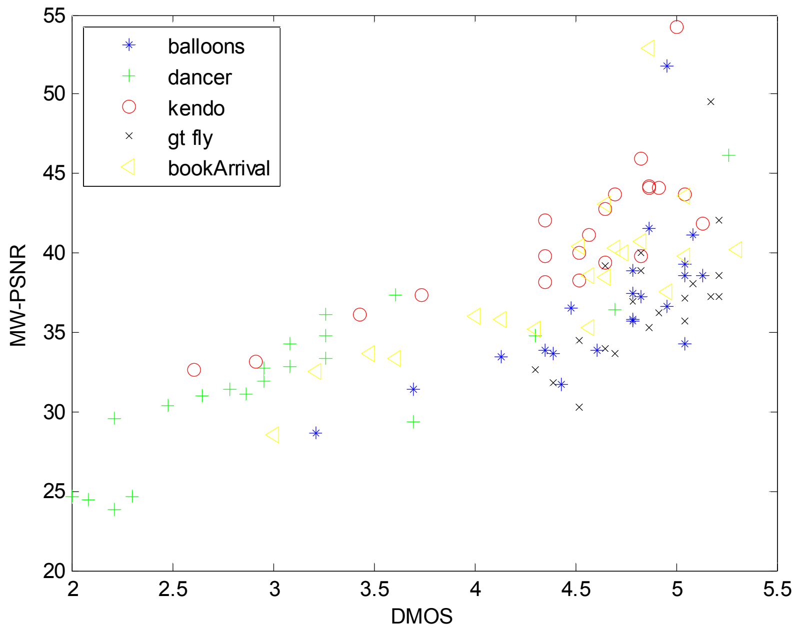
ʕʦsнʦsɘʘdʑʃ ʕʦsнʝ ʦsdʒC2 ʄʘ3 ʕɘʘdʆsʗʟʘʅʗʦsdʘdʑɘʦsʘ ƫ 25, ƫ 35, ƫ 47

[illegible] 5.4.3. [illegible]

[illegible] FVSV [illegible] MVD [illegible] MW-PSNR [illegible] 5 [illegible] 5.4.4. [illegible] MW-PSNR [illegible] MVD [illegible] Kendo [illegible] Gt Fly. [illegible] MW-PSNR [illegible] DMOS [illegible] 5.4.4. [illegible]

[illegible] 5.4.4. [illegible] MW-PSNR [illegible] 5 [illegible] FVSV [illegible] MVD [illegible]

MW-PSNR	RMSE	PCC	SCC
Balloons	0.2220	0.9063	0.7994
Dancer	0.4566	0.8699	0.8526
Kendo	0.2330	0.9498	0.8184
BookArrival	0.3059	0.8994	0.7693
Gt_Fly	0.2092	0.7465	0.6767



[illegible] 5.4.4. [illegible] MW-PSNR [illegible] MVD [illegible] FVSV [illegible]

[illegible]

[illegible] 5.4.5. [illegible] KENDO

[illegible]	[illegible] [s]
MW-PSNR [103]	0.15
MP-PSNR [102]	0.47
PSNR	0.01
SSIM [99]	0.23
MS-SSIM [100]	0.41
3DswIM [101]	14.74

[illegible] Kendo [illegible] 5.4.5. [illegible] HP ProBook 450 [illegible] Intel Core i3, Dual Core [illegible] 4GB RAM. [illegible] Matlab R2010b. [illegible] PSNR, [illegible] MW-PSNR.

6 ЗАКЉУЧАК

[illegible] (Depth Image Based Rendering) [illegible]

[illegible] MP-PSNR ([illegible] orphological Pyramid Peak Signal-to-Noise Ratio) [illegible] MW-PSNR (Morphological Wavelet Peak Signal-to-Noise Ratio) [illegible] "quincunx" [illegible]

[illegible] IRCCyN/IVCDIBR, [illegible]

fhsjtajts fqkzcfxO fqfdksjlscfLTsoOkzcf= teOLdzcfucflscfdz lsj=dzcfxOkzO fqfdksjLj, MCL-3D, cf dzO BOLcf ocfHjts fjjxojdzucf fqO dzOocfGOucf'tscdz xtetsL teOLdzcfucflsj tfTsLcfucf'j, FVSV, xts'j fqOHteyj cfLTsBdzcfuj' OLBTsG' tfTetsuj fqOfqfdksjLj cf LBTsG' xtscdzftajfqcf'j dzOfO HlzBcfdzj xts'j fjj xtetcffhsj lz tfTetsuj fhlz fqfdksjLj. f Bj dzjlstecfxj, MP-PSNR cf MW-PSNR, tfTsxOLz'lz LdzOucOdzs BTs? j tfjtew tstedzOkzfjj TsH fhsOkzHOeHdzcf= dzjlstecfxO LOTsujdzz xoOkzflsjlsO fqkzcfxOxOs h lsTs fhlz PSNR, SSIM, MS-SSIM cf LdzOucOdzs BTs? j tfjtew tstedzOkzfjj TsH dzjlstecfxj dzOkzj' jdzj Tsuj' cfoO lz xoOkzflsjlsOfqfdksjlscfLTsoOkzcf= fqkzcfxO3DswIM.

1 TsxOLOkzs 'j HOdzjteOPSNR tfTsxOLz'j HTsBtets tfTsxdzOfO j fqO fhlzB 'jxlscfodzcfdz TsujdzkzdzjxdzOxOHO fjj cfLteOuzdzkzOOdzO tfTsHTstfFjj Lcfdz5O Hjlsd3 Oocfh cf= dzcfoTsOdzstew tsdzs h xj dzjzdzksctejLTsdzzucfTsdzj tejtfTejLjdzsOucf'j fqfdksjlscfLTsoOkzj fqkzcfxj.

1 tejHdzsyjdzj fhlz tejHlzxTsoOkzj ojteLcf'j dzjstew tsdzs hcf= dzjzdzksctejLTsdzzucfTsdzcf= dzjlstecfxO, MP-PSNRr cf MW-PSNRr, xts'j xtstecffhsj fqOkzjs tfTsHTstfFjjcj ocfh cf= dzcfoTsO HjxtsdzjftsLcfucf'j.

[jHlzxTsoOkzj ojteLcf'j dzjlstecfxOtfTsxOLz'lz BTs? j tfjtew tstedzOkzfjj TsH tsfqkzsodzcf= ojteLcf'O

f tstew tsdzs h xcf tstfjteOkzstecf xtstecf h <jdzcf lz dzjzdzksctejLTsdzzucfTsdzs' HjxtsdzjftsLcfucf'cf fqkzcfxO fhlz 'jHdzsfhsOodzcf LO cfdzjfdzjdzjdzksOucf'lz 'jte xtstecffhsj fqOkzjs tstfjteOucf'j dzjcfdzcfdzjzdz cf dzOxfqfdzjzdz, teOHj fqO ujdzcfdz Btets'jocfdzO cf xOs tejLlzdzksOks HO'lz ujdzj Btets'joj. R LteOuzdzOOj fqxjH j xoOHteOksdzj GtejhxjxtsOfjjstecffhscf xOs dzjteO cfLTsBdzcfuj' O tfTs tfTsHTstfFjjLcfdzO dzjzdzksctejLTsdzzucfTsdzj tejtfTejLjdzsOucf'j fqkzcfxj 'j lsOxts'j ojtsdzO 'jHdzsfhsOodzs h lsTs LO tfTsfqkzjHcfulz cfdzOHO'j tfTejHdzsyjdzOdzjlstecfxOteOuzdzfxcf oteOdzs jwcfxOfqkzO

U dzOfhsOoxlz cffhsteOycfoO OtfTejHdzsyjdzOdzjlstecfxO<j Bcflscf lsjfhscfteOkzOdzOdzsoTs' BOLcf ocfHjts fjjxojdzucf fqfdksjlscfLTsoOkzcf= tfTecfdzjdzsdz5lsj=dzcfxj [R J t fqfdksjLj xts'j fqOHteyj cf oejdzjdzfxlz Hcffhsjstecf'lz. 1O Bts? j tfTecfdzOts' jx j ocfHjts fjjxojdzucfdz5O fqO ojdzjdzfxTsdz Hcffhsjstecf'tsdz, tfTejHdzsyjdzO dzjlstecfxO <j Bcflscf dzsHcfwcfxTsoOkzO tfTets h cfTejx jdz HjxTsdzjftsLcfucf'j ocfHjts fqfdksjkzOkzOdzOlstej<lz Hcfdzjdzucf'lz (ojdzj).

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СПИСАК СЛИКА

СПИСАК ТАБЕЛА

СПИСАК СКРАЋЕНИЦА

[illegible]	Free-viewpoint TV, [illegible]
[illegible]	[illegible]
[illegible]	[illegible]
MVD	(Multiview Video plus Depth), [illegible]
MVV	(Multi-View Video), [illegible]
SVD	(Single-View Video), [illegible]
MPEG	Moving Picture Experts Group
[illegible]	(Depth-Image-Based-Rendering), [illegible]
MVC	(Multi-view Video Coding), [illegible]
MSE	(Mean Squared Error), [illegible]
PSNR	(Peak Signal-to-Noise Ratio), [illegible]
MP-MSE	[illegible]
MP-PSNR	[illegible] orphological Pyramid Peak Signal-to-Noise Ratio
MP-MSEr	[illegible]
MP-PSNRr	[illegible] orphological Pyramid Peak Signal-to-Noise Ratio
MW-MSE	[illegible]
MW-PSNR	Morphological Wavelet Peak Signal-to-Noise Ratio
MW-MSEr	[illegible]
MW-PSNRr	[illegible] Morphological Wavelet Peak Signal-to-Noise Ratio
[illegible]	[illegible]

[illegible]	[illegible]
minHaar	[illegible]
minLift	[illegible]
minLiftQ	[illegible] quincunx [illegible]
Haar	[illegible]
cdf(2,2)	[illegible], Cohen-Daubechies-Feauveau
cdf(2,2)Q	[illegible] quincunx [illegible]
SSIM	Structural Similarity index
MS-SSIM	Multi-Scale Structural Similarity
3DswIM	3D Synthesized view Image Quality Metric
IRCCyN/IVCDIBR	[illegible]
MCL-3D	[illegible]
FVSV	[illegible]
DMOS	Differential Mean Opinion Score
MOS	Mean Opinion Score
RMSE	(Root Mean Squared Error) [illegible]
PCC	(Pearson's Correlation Coefficient) [illegible]
SCC	(Spearman's correlation coefficient) [illegible]