Realistic Image Synthesis research at MPI Informatik

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Research From Saarbrücken

• Some examples

High Dynamic Range (HDR) Imaging



HDR Imaging Pipeline



Tone Mapping



MPI HDR Software

PFSTools For High Dynamic Range Images and Video



http://pfstools.sourceforge.net/

PFStmo tone mapping operators

http://www.mpii.mpg.de/resources/tmo/

PFS Calibration of HDR and LDR Cameras

http://www.mpii.mpg.de/resources/hdr/calibration/pfs.html

HDR Visual Difference Predictor

http://www.mpi-sb.mpg.de/resources/hdr/vdp/index.html

GPL License

Overcoming Display Limitations

- Enhancing apparent (perceived) quality rather than improving technical aspects
- Take advantage of the visual system properties



Cornsweet Illusion



Glowing Effect



[Zavagno and Caputo 2001]

Apparent Resolution Enhancement



Optimization Result

Display



Predicted image on the retina

integration

TWO HOUSEHOLDS, BOTH ALIKE IN DIGNITY, I MUTINY, WHERE CIVIL BLOOD MAKES CIVIL H STAR-CROSS'D LOVERS TAKE THEIR LIFE: WH PARENTS' STRIFE. THE FEARFUL PASSAGE OF BUT THEIR CHILDREN'S END, NOUGHT COULD PATIENT EARS ATTEND, WHAT HERE SHALL M VERONA, WHERE WE LAY OUR SCENE, FROM / UNCLEAN, FROM FORTH THE FATAL LOINS OF MISADVENTURED PITEOUS OVERTHROWS DO DEATH-MARK'D LOVE, AND THE CONTINUANCE IS NOW THE TWO HOURS' TRAFFIC OF OUR ST SHALL STRIVE TO MEND.TWO HOUSEHOLDS, GRUDGE BREAK TO NEW MUTINY, WHERE CIVI FOES A PAIR OF STAR-CROSS'D LOVERS TAK THEIR PARENTS' STRIFE. THE FEARFUL PASSA WHICH, BUT THEIR CHILDREN'S END. NOUGHT WITH PATIENT EARS ATTEND, WHAT HERE SH FAIR VERONA, WHERE WE LAY OUR SCENE, FI UNCLEAN FROM FORTH THE FATAL LOWS OF

3D Image Retargeting



Visible Difference Metric (VDP)

 Can the human eye see the differences between two images?



Dataset of Visible Distortions

Peter Panning



Shadow acne



[Piórkowski et al. 2017]

Z-fighting



Shadowmap downsampling



Dataset of Visible Distortions

Aliasing



[Piórkowski et al. 2017]





[Adhikarla et al. 2017]

Perception patterns



[Čadík et al. 2013]

Deghosting



[Karađuzović-Hadžiabdić et al. 2017]

Label Creation



Label Creation



Neural Network Architecture



Multi-material Printing



Stratasys J750 (poly-jetting printer)



Vero Opaque materials (not actually opaque!)



Goal: Visually Reducing Light Diffusion in the 3D Printed Material

Without correction (MC simulation)



Target texture

With correction (MC simulation)

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Volumetric MC global illumination simulation



despite the non-linearity of the appearance, it changes monotonically → simple residual energy minimization



Varifocal Displays



Membrane AR – Dunn et al.

Deformable Beamsplitter



Dynamic focal depth: objects at any depth

Wide field of view

Optics are simple

Membrane AR – Dunn et al.

Deformable Beamsplitter



Membrane AR – Dunn et al.

Multi-focal Plane Display





15cpd, 40 deg, 1200x1200 pixels

Multi-focal Plane Display

Temporal coherency



Saccade in Foveated Rendering



Saccade Landing Position Prediction for Gaze-Contingent Rendering

Saccade in Foveated Rendering



Saccade Landing Position Prediction for Gaze-Contingent Rendering















Luminance-Contrast-Aware Foveated Rendering

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More Visible

Luminance-Contrast-Aware Foveated Rendering



Sampling Patterns



Advanced Sampling

How error in MC integration is affected by different sampling patterns?

Spatial domain statistics: Pair Correlation Function / Discrepancy

Fourier domain statistics

Define Error in terms of Spatial and Fourier domain statistics

Learn to Render: Path to Neural Networks



TRAINING

TEST

© Disney / Pixar

Bako et al.[2017]

Our Focus: Learn to Render

- ML/NN algorithms for denoising
- CNNs/GANs (unstructured)
- Learning Light Transport the Reinforced Way
- Learning to Importance
 Sample



