KEYNOTE TALK Monday, December 14, 2015 8:30 AM – 9:30 AM / Ballroom 5

ISVC 2015: 11th International Symposium on Visual Computing

Sampling and Reconstruction of High-Dimensional Visual Appearance

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Abstract

Many problems in computer graphics and computer vision involve high-dimensional 3D-8D visual datasets. Realtime image synthesis with changing lighting and view is often accomplished by pre-computing the 6D light transport function (2 dimensions each for spatial position, incident lighting and viewing direction). Realistic image synthesis also often involves acquisition of appearance data from real-world objects; a BRDF (Bi-Directional Reflection Distribution Function) that measures the scattering of light at a single surface location is 4D and spatial variation and subsurface scattering involve 6D-8D functions. In computer vision, problems like lighting insensitive facial recognition similarly involve understanding the space of appearance variation across lighting and view. Since hundreds of samples may be required in each dimension, and the total size is exponential in the dimensionality brute force acquisition or pre-computation is often not even feasible. In this talk, we describe a signal-processing approach that exploits the coherence, sparsity and inherent low-dimensionality of the visual data, to derive novel efficient sampling and reconstruction algorithms. We describe a variety of new computational methods and applications, from affine wavelet transforms for real-time rendering with area lights, to space-time and space-angle frequency analysis for motion blur and global illumination, to compressive light transport acquisition. In computer vision, we introduce a new framework of differential photometric reconstruction to tame the complexity of real-world reflectance functions. The results point toward a unified sampling theory applicable to many areas of signal processing, computer graphics and computer vision.



Speaker Bio-Sketch: Ravi Ramamoorthi is a professor of Computer Science and Engineering at the University of California, San Diego, and Director of the UC San Diego Center for Visual Computing. He joined the department in Jul 2014, moving from a tenured faculty appointment at the EECS department in UC Berkeley, where he had been since January 2009. Earlier, he was on the faculty of the Computer Science Department at Columbia University since August 2002, when he received his PhD from Stanford University. He obtained his BS and MS degrees in computer science and physics from the California Institute of Technology in 1998. Prof. Ramamoorthi is an author of more than 100 refereed publications in computer graphics and computer vision, including 50 at ACM SIGGRAPH/TOG, and has played a key role in building

multi-faculty research groups that have been recognized as leaders in computer graphics and computer vision at Columbia, Berkeley and UCSD. His research has been recognized with a half-dozen early career awards, including the ACM SIGGRAPH Significant New Researcher Award in computer graphics in 2007, and the Presidential Early Career Award for Scientists and Engineers (PECASE) for his work in physics-based computer vision in 2008. Prof. Ramamoorthi's work has had substantial impact in industry, with techniques like spherical harmonic lighting being adopted in industry-standard RenderMan software, and widely used in interactive applications and movie productions; he has consulted with Pixar and startups in computational imaging. He has graduated more than 20 postdoctoral, Ph.D. and M.S. students, many of whom have taken positions at leading universities or research labs, and he has taught the first open online course in computer graphics as one of the first nine classes on the EdX platform, with more than 80,000 registrations to date and a Chinese translation available via XuetangX; his online videos have been watched more than 300,000 times.