Tutorial: Theory and Methods of Light-Field Photography

Date: Tuesday, April 15th
Time: 14:00 - 17:30 (**Half-day Tutorial)**

Presenters:
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Abstract: Computational photography is based on capturing and processing discrete representations of all the light rays in the 3D space. Compared to conventional photography, which captures 2D images, computational photography captures the entire 4D "lightfield", i.e., the full 4D radiance. To multiplex the 4D radiance onto conventional 2D sensors, light-field photography demands sophisticated optics and imaging technology. At the same time, 2D image creation is based on creating 2D projections of the 4D radiance.

This tutorial presents light-field analysis in a rigorous mathematical way, which often leads to surprisingly direct solutions. The mathematical foundations will be used to develop computational methods for lightfield processing and image rendering, including digital refocusing and perspective viewing. While emphasizing theoretical understanding, we also explain practical approaches and engineering solutions.

As part of the course, we will demonstrate a number of working light-field cameras that implement different methods for radiance capture, including the microlens approach of Lippmann and the plenoptic camera; the MERL mask enhanced camera; the Adobe lens-prism camera; and a new camera using a "mosquito net" mask. Various computational techniques for digital refocusing and rendering will also be demonstrated, including Ng's Fourier slice algorithm and the MERL heterodyned light-field approach.

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Todor Georgiev is a researcher in Adobe, working close with the Photoshop group. Having extensive background in theoretical physics, he concentrates on applications of mathematical methods taken from physics to image processing, graphics and vision. He is the author of the Healing Brush tool in Photoshop (2002), the method better known as Poisson image editing. He has published several articles on applications of the mathematics of covariant derivatives in image processing and vision. He is working on a wide range of theoretical and practical ideas in optics, light field cameras and capture/manipulations of the optical field. His recent works concentrate on light field camera designs. He has a number of papers and patents in the related areas.