



## Professor Changhuei Yang

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# Focusing light into biological tissues with wavefront engineering

I will discuss two lines of wavefront engineering work going on in my group. Time-Reversal Optical Focusing: We appear opaque because our tissues scatter light very strongly. Traditionally, focusing of light in biological tissues is confounded by the extreme scattering nature of tissues. Interestingly, optical scattering is time-symmetric and we can exploit optical phase conjugation methods to null out scattering effects. I will discuss our recent results in using different types of guidestar methods in combination with digital optical phase conjugation to tightly focus light deep within biological tissues. I will report on our recent demonstrations of time-reversal focusing to activate optogenetic agents through millimeter thick brain sections. Fourier Ptychography-Microscopes are complex and fussy creatures that can only deliver limited image information. This is because physical optical lenses are intrinsically imperfect. The perfect lenses we draw in high school ray diagrams simply do not exist.

I will discuss our recent work on Fourier Ptychographic Microscopy – a computational microscopy method that enables a standard microscope to push past its physical optical limitations to provide gigapixel imaging ability.

Professor Yang's research efforts are in the areas of novel microscopy development and time-reversal based optical focusing. Prof. Yang joined the California Institute of Technology in 2003. He is a professor in the areas of Electrical Engineering, Bioengineering and Medical Engineering. He has received the NSF Career Award, the Coulter Foundation Early Career Phase I and II Awards, and the NIH Director's New Innovator Award. In 2008 he was named one of Discover Magazine's '20 Best Brains Under 40'. He is a fellow of the Coulter foundation, AIMBE, OSA and SPIE.

**Wednesday, December 7<sup>th</sup>, 2016**  
**13:00**

