# Ultrafast X-ray Imaging of Magnetic Materials

R. Kukreja

University of California, Davis, USA, **rkukreja@ucdavis.edu**

Spin transport is the key for reading or writing bits in spintronic devices by utilizing the Giant Magnetoresistance effect or the spin transfer torque effect. Spin currents have also been shown to play important role in the ultrafast manipulation of magnetization via all optical switching. Hence, detailed understanding of spin currents is a crucial step in development of spintronic devices. In this talk, I will describe our recent experimental studies using emerging synchrotron and free electron laser techniques that can probe these materials with both high spatial and temporal resolution. I will discuss our work on imaging spin dynamics in nano-devices and probing spin transport across ferromagnet/copper interface. We have developed an extremely sensitive spectro-microscopy detection method based on element specific X-ray magnetic circular dichroism to probe spin transport in Co/Cu devices. The sensitivity of this new 'lock-in' technique has allowed us to detect the extremely small transient Cu magnetization with sub 100 nm spatial resolution. This technique has also enabled imaging of nanoscale motion of localized nonlinear spin waves in spin torque oscillator, allowing a detailed insight into p-like character of localized spin-wave excitation. I will also discuss our recent work on ultrafast imaging following optical pumping at free electron laser sources.