Photonic devices in motion
-- Optomechanics and microwave frequency acousto-optics

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Abstract:
Numerous optical instruments exploit spatial and temporal coherence of light to perform measurement by mechanically moving the optical components inside. In integrated optical devices, however, every optical component is carved into the chip. Thus their optical functions can hardly be changed despite there is need to control their properties dynamically. In this talk, I will present several different ways to exploit the mechanical degree of freedom created in integrated photonic devices in order to reconfigure their functions, to achieve high precision measurement of minute forces and to couple microwave with light. We first demonstrate strong forces can be generated by light confined in silicon photonic waveguides to excite the device’s mechanical vibration. We experimentally prove the theoretical prediction that this new optical force is bipolar – its direction can be tuned to be attractive or repulsive by changing the relative optical phase of coupled lightwaves, resembling the Coulomb force between positive and negative charges. We show the exploitation of optical forces in a variety of interesting optomechanical structures, including photonic crystal cavities and a photonic see-saw, and the application of optomechanics in advanced sensing and optical communication. Second, we will show that gigahertz surface acoustic waves (SAW) with sub-optical wavelength can be excited on the surface of piezoelectric substrates to strongly modulation light in integrated photonic cavities. This leads to a new category of piezo-photonic device with potential applications in microwave photonics and quantum photonics. Finally, we will demonstrate processes to fabricate flexible and tunable photonic devices and to achieve heterogeneously integrated photonic devices for broadband operation.

Reference:

Biography:
Mo Li is an assistant professor and McKnight Land-Grant Professor in the Department of Electrical and Computer Engineering at the University of Minnesota. From 2007 to 2010, he was a postdoctoral associate in Department of Electrical Engineering at Yale University. He received his Ph.D. degree in Applied Physics from Caltech in 2007. He has been the recipient of a NSF CAREER Award in 2014, a McKnight Land-Grant Professorship in 2013 and an AFOSR Young Investigator Award in 2012. His primary research interests are NEMS/MEMS, nanophotonics, nano-optomechanical systems (NOMS), quantum enhanced measurement and sensing.