UNIVERSITY of HOUSTON | ENGINEERING

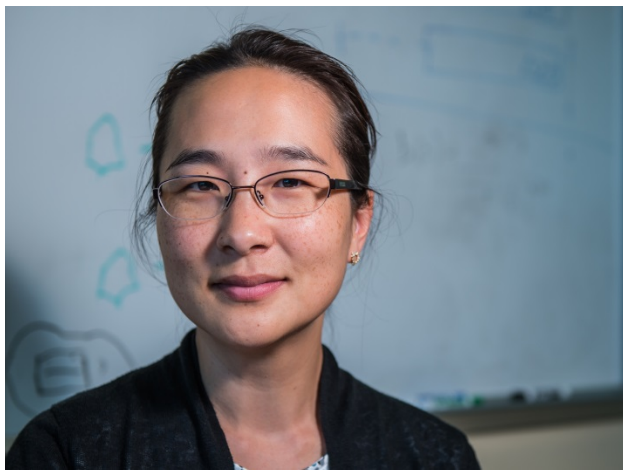
Department of Biomedical Engineering

Seminar

Synthetic Virology: Reprogramming Viruses into Controllable Nanodevices

Friday, December 2, 2016
SEC 204: 12-1PM

Speaker: Dr. Junghae Suh



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Abstract: Viruses are nature's nanomachines that already conduct amazing feats of biomolecular computation – they have evolved to recognize specific biomolecular inputs and produce functional outputs critical to the infection of their host organisms. Viruses have been harnessed over the last several decades as gene delivery vectors for a variety of biomedical applications. To make viral gene delivery a more predictable process, we must obtain control over the naturally encoded biomolecular programs already embedded in the viral capsids. Over the last several years, we have purposefully investigated ways to rewrite the details of what cues can be accepted as input and what functional outputs can be produced by the capsids. For example, we are in the initial stages of programming defined logic operators into the virus nanostructure and have successfully created virus prototypes that are activated by extracellular proteases. These protease-activatable viruses can be used for the treatment of diseases that exhibit signs of inflammation, such as cancer and a number of cardiovascular diseases. We are also investigating ways to render the viral transduction process controllable by externally applied light, which may enable enhanced, tunable, and spatially resolved transgene expression in target tissues. This effort represents a merger of virus capsid engineering and optogenetics (light-switchable proteins that can control biological processes) to

create ‘bionic’ viruses with newfound abilities. Collectively, our work demonstrates how virus capsids can be designed to compute different aspects of their environment and to use this information to decide whether or not they perform a user-programmed output. Such synthetic viruses may find broad utility in the future as sophisticated biosensing and biomanipulating materials.

Bio: Dr. Suh received her S.B. in Chemical Engineering from MIT in 1999 and a Ph.D. in Biomedical Engineering from Johns Hopkins School of Medicine in 2004. Before joining the Rice University department of Bioengineering as an assistant professor in 2007, she completed a two-year postdoctoral fellowship in the Laboratory of Genetics at the Salk Institute for Biological Studies. Her graduate research focused on understanding the interation of nanoscale systems, either nature-derived or human-engineered, with complex biological environments in an effort to discover ruling paradigms that govern the performance of nanoparticles designed for biomedicine. Her postdoctoral research focused on how natural viruses interface with cellular machinery, particularly those that maintain homeostasis in the cell nucleus. Such studies should uncover new insights into how synthetic nanoparticle systems can be designed to yield the performance efficiencies rivaling that of viruses. Currently, Dr. Suh works at the interface of virology, biophysics, molecular biology, and protein engineering to investigate and create virus-based materials for biomedical applications. By manipulating the “inputs” and “outputs” of virus nanoparticles, she endeavors to develop platform technologies that can be used as therapeutics for a broad range of human diseases. She was awarded the NSF CAREER Award and the MDACC Ovarian Cancer SPORE Career Development Program Award for her innovative work on reprogramming viruses as therapeutic platforms. Most recently, Dr. Suh was awarded the Outstanding New Investigator Award from the American Society for Gene and Cell Therapy. Her work is currently funded by the National Institutes of Health, National Science Foundation, and the American Heart Association.