Flow that approaches the junction of a bluff body and its endwall will separate and roll up into a large vortex structure at the leading edge of the body. The leading-edge junction vortex is known to be unsteady, which can locally cause high heat transfer in turbomachines, significant pressure fluctuations (noise) at aircraft body-wing junctions, or riverbed scouring in front of piers. However, most research to date has examined this flow phenomenon in clean inlet flows. The work presented here investigates the behavior of the junction vortex in the complex flowfield generated by a staggered array of cylinders, known as a pin fin array. In this case, wake shedding from upstream cylinders results in significant freestream vorticity that interacts with the junction vortex at the base of a cylinder. Time-resolved measurements of the junction vortex were obtained using a high-resolution particle image velocimetry system at three rows in a pin fin array. The time-mean shape of the junction vortex became more compact in the first row with increasing Reynolds number, but the shape was mostly invariant with row location or Reynolds number for downstream rows. Bi-modal distributions of velocity were found in all rows, and were a result of two primary modes of the junction vortex. The implications of these results on heat transfer in a pin fin array (generally desirable) will also be discussed.

Biography: Dr. Stephen Lynch is an assistant professor in the Mechanical and Nuclear Engineering department at Penn State University. He received his BSME from the University of Wyoming, and his MSME and PhD from Virginia Tech. He spent two years as a senior research engineer at United Technologies Research Center in East Hartford, CT before joining Penn State. He currently directs the Experimental and Computational Convection Laboratory (ExCCL), and his research focuses on highly resolved measurements and computations of convective heat transfer, particularly for gas turbine related applications. He was also recently awarded an Office of Naval Research Young Investigator award on the topic of the dynamics of the junction vortex.