Sub-sampling Approaches to Mapping and Imaging

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Abstract: Sub-sampling approaches can greatly reduce the amount of data that needs to be gathered and stored when exploring an unknown signal or environment. When combined with optimization algorithms, accurate reconstructions from the sub-sampled data can be generated, even when acquiring far less than Nyquist-Shannon theory requires. In this talk we explore the use of such schemes in two disparate application domains. The first is in nanometer-scale imaging using an atomic force microscope. Here, sub-sampling can significantly increase the imaging rate for a given image resolution, providing more speed without the need to upgrade the microscope hardware. The second is in robotic mapping where sub-sampling followed by reconstruction can greatly reduce the number of measurements needed to produce accurate maps. This reduction becomes especially important when considering exploration using next generation, small-scale robots such as Harvard’s RoboBee or TU Delft’s DelFly where onboard power, computation, and storage resources are extremely limited.

Bio: Sean Andersson received his B.S. in Engineering and Applied Physics from Cornell University (1994), his M.S. in Mechanical Engineering from Stanford University (1995), and his Ph.D. in Electrical and Computer Engineering from the University of Maryland, College Park (2003). He has worked as a Project Engineer for AlliedSignal Aerospace (1995), a Senior Controls Engineer for Aerovironment (1996-1998), and as a Lecturer in Applied Mathematics at Harvard University (2003-2005). He is currently an Associate Professor of Mechanical Engineering and of Systems Engineering at Boston University. His research interests include systems and control theory with applications in scanning probe microscopy, dynamics in molecular systems, robotics, and multi-agent systems. He received the NSF CAREER award in 2009 and served as an Associate Editor for the IEEE Transactions on Automatic Control (2013-2018) and the SIAM Journal on Control and Optimization (2013-2018).