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From real world problems to esoteric research: examples and personal experience

ABSTRACT – Young (and some not-so-young) researchers often wonder how to extract good research ideas and develop useful methodologies from solving real world problems. The path is rarely straightforward and its success depends on the circumstances, tenacity and luck. I will use three examples to illustrate how I trod the path. The first involved an attempt to find optimal growth conditions for nano structures. It led to the development of a new method "sequential minimum energy design (smed)", which exploits an analogy to potential energy of charged particles. After a few years of frustrated efforts and relentless pursuit, we realized that smed is more suitable for generating samples adaptively to mimic an arbitrary distribution rather than for optimization. The main objective of the second example was to build an efficient statistical emulator based on finite element simulation results with two mesh densities in cast foundry operations. It eventually led to the development of a class of nonstationary Gaussian process models that can be used to connect simulation data of different precisions and speeds. The third example is about sequential design that works well for small samples in sensitivity testing. I will describe three major papers in a span of 30 years and how each paper had one new idea that inspired the next paper. In each example, the developed methodology has broader applications beyond the original problem. I will explain the thought process and de-emphasize the statistical details. Finally, I will share some secrets about a "path to innovation".

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SPEAKER BIO – C. F. Jeff Wu is Professor and Coca Cola Chair in Engineering Statistics at the School of Industrial and Systems Engineering, Georgia Institute of Technology. He was the first academic statistician elected to the National Academy of Engineering (2004); also a Member (Academician) of Academia Sinica (2000). A Fellow of American Society for Quality, Institute of Mathematical Statistics, of INFORMS, and American Statistical Association. He received the COPSS (Committee of Presidents of Statistical Societies) Presidents' Award in 1987, the COPSS Fisher Lecture Award in 2011, the Deming Lecture Award in 2012, and numerous other awards and honors. He has published more than 140 research articles and supervised 41 Ph.D.'s. He has published two books "Experiments: Planning, Analysis, and Parameter Design Optimization" (with Hamada) and "A Modern Theory of Factorial Designs" (with Mukerjee).