# Computer model calibration as a method of selecting material properties for design of a wind turbine blade

1. Overview of NSF-DEMS project goals
2. Background and conceptual underpinnings
   1. Explanation of Gaussian processes
   2. Explanation of Gaussian process regression
   3. Background on the use of Gaussian processes for computer model calibration
3. The emulator
   1. Description of the finite element model to be emulated
   2. Mathematical basis for the emulator (formulae for trained mean and covariance functions)
   3. Design used to sample the simulator
   4. Covariance parameters for the emulator and how they were selected
      1. Computational difficulties (and how they complicate the use of MCMC here)
      2. Using a grid optimization framework: advantages and disadvantages
      3. Gradient descent method: explanation and advantages
   5. Normalization of the emulator inputs, and standardization of the outputs
   6. Computational difficulties and solutions
      1. Use of log-likelihoods
      2. Use of covariance matrix nuggets
4. The MCMC routine and results
   1. Background on MCMC
   2. Choice of priors and resulting posterior likelihood
      1. Selection of observation variance prior
         1. Setting constant observation variance at 2 s.d.’s positive
         2. Setting constant homoskedastic observation variance
         3. Setting prior on homoskedastic observation variance
         4. Setting prior on heteroskedastic observation variance
      2. Full model description and likelihood
      3. Computational difficulties and solutions
         1. Log-likelihoods
         2. Parallelization of multiple chains
   3. Elimination of boundary constraints: why and how
      1. Problems with ignoring boundary constraints
      2. Metropolis-Hastings algorithm background
      3. Implementation of M-H algorithm
   4. Choice of desired data
      1. Motivations driving the choice of desired data
      2. Results of selecting different values of desired data
   5. Taking the desired data to be exponentially rather than normally distributed
      1. Motivation
      2. Implementation and results
   6. Issues arising from the non-identifiability of volume fraction, thickness when cost is relaxed
5. Future work
   1. Alternative means of handling cost
      1. Removing cost from the model
      2. Placing a prior on VF, thickness as a means of controlling cost
   2. Creation of a response surface of model output at posterior means given desired data
   3. Implementation of Hamiltonian Monte Carlo technique
      1. Background on HMC
      2. Implementation and expected benefits
   4. Inclusion of discrepancy function
6. Conclusion: discussion of the role of computer model validation as a potential methodology for design