**Title:** Bilinear and parallel prediction methods

**Abstract:**

To make accurate predictions about a system one must develop a model for that system.  Bilinear models are often attractive options because they allow the user to model nonlinear interactions between variables in complicated systems with (potentially) millions of variables.  In this work we apply bilinear models to two separate domains and present novel models for improved prediction accuracy and novel heuristics for solving the optimization problems that arise from the use of bilinear models.

In the first system we use a bilinear model to predict the remaining useful life (RUL) of a rechargeable lithium-ion (Li-ion) battery.  The approach used to solve the bilinear model leverages bilinear kernel regression to build a nonlinear mapping between the capacity feature space and the RUL state space.  Specific innovations of the approach include: a general framework for robust sparse prognostics that effectively incorporates sparsity into kernel regression and implicitly compensates for errors in capacity features; and two numerical procedures for error estimation that efficiently derives optimal values of the regression model parameters.

Second, we apply a bilinear model to the matrix completion problem, where one seeks to recover a data matrix from a small sample of observed entries.  We assume the matrix we wish to recover is low-rank (the rank of the matrix is much less than either dimension) and model it as the product of two low-rank matrices.  We then adapt existing parallel solutions to this model for use on a graphics processing unit (GPU).  Additionally,  we introduce a novel method for inductive matrix completion on a GPU.