1154-35-1292 **Johann Rudi*** (jrudi@anl.gov), **Georg Stadler**, **Jiashun Hu**, **Micheal Gurnis** and **Omar Ghattas**. *Inference of Uncertain Parameters in Physical Models Governed by PDEs with Application to Earth's Mantle Convection.*

We consider maps from a set of parameters to a set of quantities of interest that we seek to calibrate to observational data. In particular, we focus on maps that incorporate physical models in form of PDEs. Computing the solution of the parameter-to-observable map constitutes a forward problem, while finding parameters such that the model output is consistent with observational data amounts to an inverse problem.

We present computational methods for large-scale inverse problems posed in a Bayesian statistical framework by introducing a Gaussian prior distribution for the uncertain parameters. The maximum a posteriori (MAP) estimate and an approximation of parameter uncertainties at this MAP point is obtained from the solution of an optimization problem governed by the model PDE and second-order derivatives (Hessians). Newton's method is used for solving the optimization problem, which requires first- and second-order derivatives of the parameter-to-observable map. These operations are performed in an efficient and scalable fashion using adjoint methods. This algorithmic approach is independent of the problem under consideration, however we showcase its strengths on a model of Earth's mantle convection with velocities at the surface as observations. (Received September 14, 2019)