

Current Research Activities

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Current Research Group

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Sheldon Lee

Rebecca Mckeown

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We focus on the computational aspects of error estimation, sensitivity analysis, uncertainty quantification, data assimilation, etc.

Research Activities (In no particular order!)

A posteriori analysis of operator decomposition

- Operator decomposition and multiscale time integrators for evolution problems
Coupling core and edge physics in a fusion reactor
- Treating “black box” components in elliptic systems
Radiative heat transfer
- Coupling stochastic models to continuum models
Coupling molecular dynamics to elliptic problems and protein folding

A posteriori analysis of numerical methods for partial differential equations with geometric constraints

Geometric PDES, black hole models

Research Activities (In no particular order!)

Density estimation for differential equations

- Fast methods for density estimation, both deterministic and probabilistic
- Dealing with time dependent random parameters
- Estimation for rough random perturbations to parameters in elliptic problems

Flow through porous medium

- Partial differential equations with uncertain domains
Fuel rods in a nuclear reactor, protein folding

Computing statistics of large communication networks using PDEs, network optimization and design

Wireless sensor networks

Research Activities (In no particular order!)

Inverse density estimation

- Solving the inverse density estimation problem in the space of contours of the response surface
- Efficient determination of possible input distributions for a given distribution on an output
Determining accuracy required on data input in a differential equation, e.g. from satellites, ground measurements
- Data assimilation, including sensitivity information
climate modeling, modeling the terrestrial carbon cycle, small angle x-ray scattering

Uncertainty analysis of population models

Determining recovery of endangered species
Sensitivity analysis of disease models, e.g. black plague
Deriving stochastic models from differential equations

Research Activities (In no particular order!)

Software for error estimation, adaptive error control, and sensitivity analysis

- Globally Accurate Adaptive Sensitivity Package (GAASP)
- Implementation of “user-friendly”, flexible and efficient adjoint-based a posteriori error estimates for evolution problems
- Parallel adaptivity

Compensated domain decomposition for evolution problems