Applications of Stochastic Fractional Partial Differential Equations

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The solution to certain types of fractional SPDEs, e.g.,

$$\left(\kappa^2 - \nabla^2\right)^{\alpha/2} u(\boldsymbol{x};\omega) = \dot{W}(\boldsymbol{x};\omega) \qquad \alpha = 1, 2, \ldots$$

can be well approximated by Gaussian Markov Random Fields (GMRF) [1]

$\Downarrow$

Sparse precision matrices and fast algorithms

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Fast Bayesian Inference for big data
- Surrogate-based design/optimization [2] (kriging/co-kriging)
- Spatio-temporal modeling in geosciences [1]

[1] F. Lindgren, H. Rue and J. Lindström, "An explicit link between Gaussian fields and Gaussian Markov random fields: the stochastic partial differential equation approach", *J. Roy. Stat. Soc. B*, 2011, **73** (4), pp. 423-498.

[2] A. I.J Forrester, A. Sóbester and A. J. Keane, "Multi-fidelity optimization via surrogate modelling" *Proc. R. Soc. A*, 2006, **463**, doi: 10.1098/rspa.2007.1900.