Incorporating geometry into machine learning models

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Joint work with Viacheslav Borovitskiy,* Iskander Azangulov,*
Peter Mostowsky,* and Marc Deisenroth

Talk for TheAlgo

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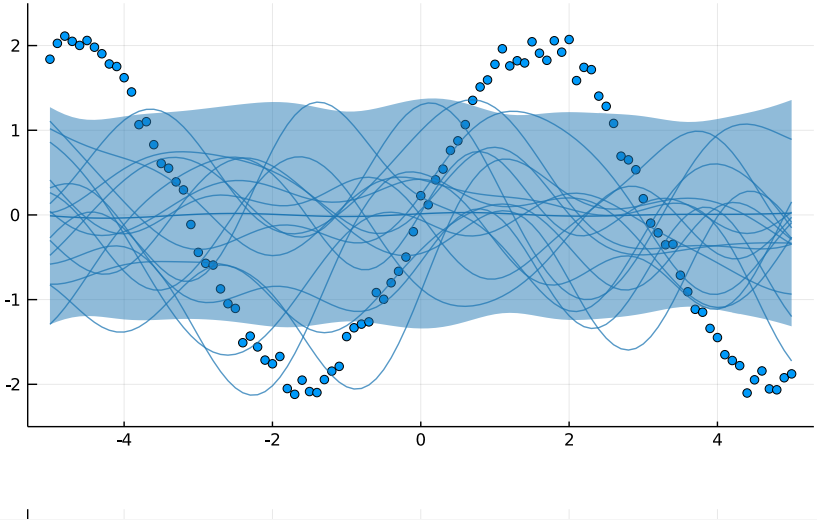
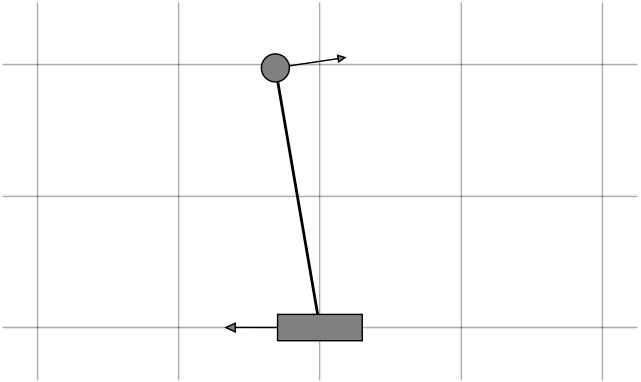
*Equal contribution

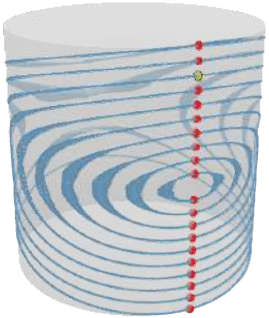
Gaussian processes

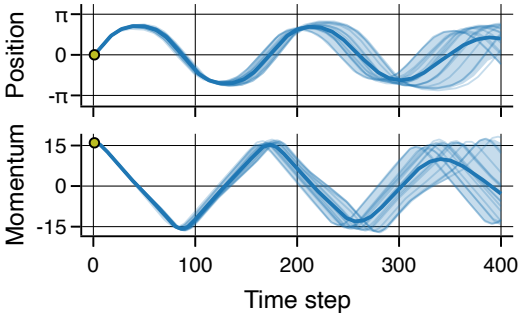


Modeling dynamical systems



Modeling dynamical systems





Matérn Gaussian processes on Riemannian manifolds

Viacheslav Borovitskiy,* Alexander Terenin,* Peter Mostowsky,* and Marc Deisenroth

*Equal contribution

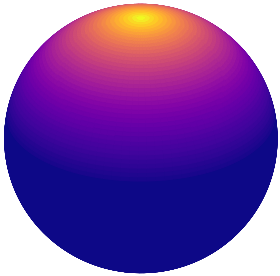
NeurIPS 2020

Matérn Gaussian processes on Riemannian manifolds

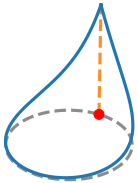
$$f : M \to \mathbb{R}$$

M: Riemannian manifold (circle, sphere, cylinder, many others)

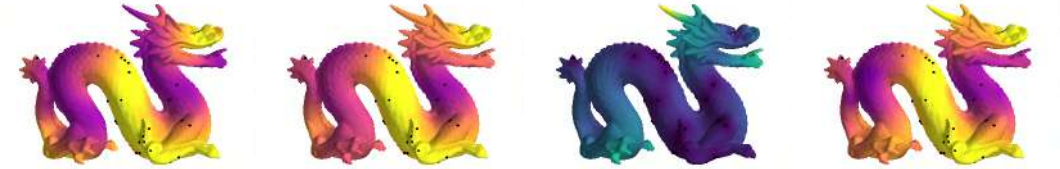
Key technical tools: stochastic partial differential equations and spectral theory



Dependence between nearby points

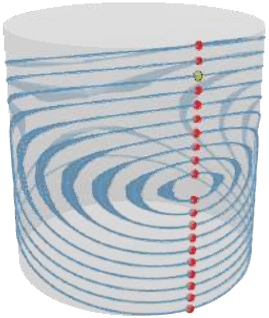


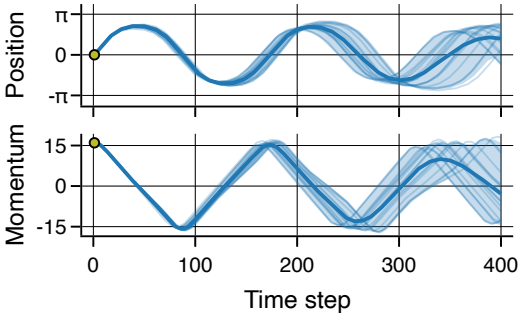
Trained models



(a) Ground truth (b) Posterior mean (c) Standard deviation (d) One posterior sample

Modeling dynamical systems





Matérn Gaussian processes on Graphs

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Peter Mostowsky, Marc Deisenroth, and Nicolas Durrande





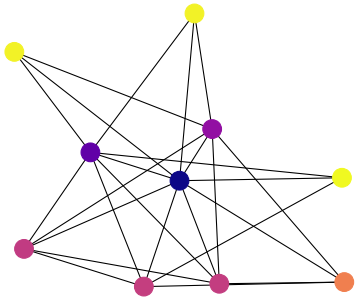
[*]Equal contribution

Matérn Gaussian processes on Graphs

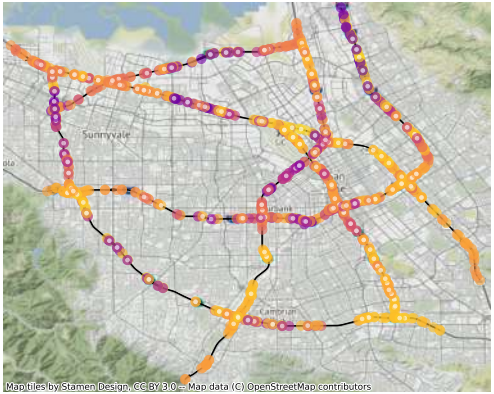
$$f : G \to \mathbb{R}$$

G: weighted undirected graph

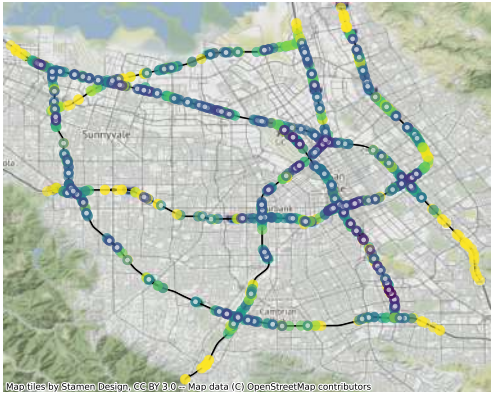
Key technical tools: graph Laplacian and spectral theory



Trained models



(a) Predictive mean



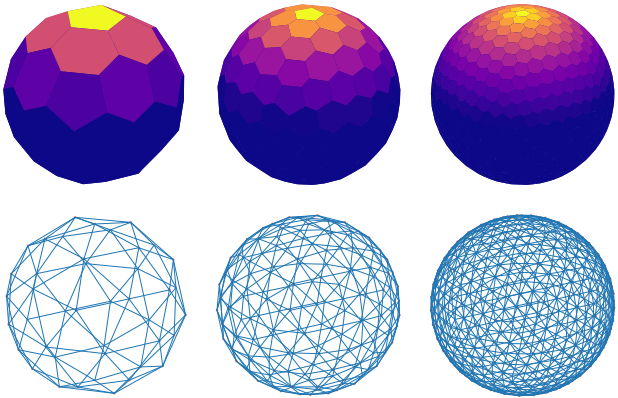
(b) Standard deviation

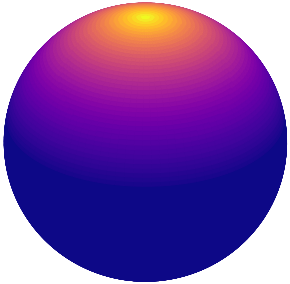
Trained models

(a) Predictive mean

(b) Standard deviation

Convergence to manifold limit





Concluding remarks

Thank you for your attention!

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V. Borovitskiy,* A. Terenin,* P. Mostowsky,* M. P. Deisenroth. Matérn Gaussian Processes on Riemannian Manifolds. Advances in Neural Information Processing Systems, 2020. *Equal contribution.

V. Borovitskiy,* I. Azangulov,* A. Terenin,* P. Mostowsky, M. P. Deisenroth, N. Durrande. Matérn Gaussian Processes on Graphs. arXiv:2010.15538, 2020. *Equal contribution.