

## **Bayesian Non-Linear Subspace Shrinkage using Horseshoe Priors**

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### **Abstract:**

When modeling biological responses using Bayesian nonparametric regression, prior information may be available on the shape of the response in the form of non-linear function spaces that define the general shape of the response. To incorporate such information into the analysis, we develop a non-linear functional shrinkage (NLFS) approach that uniformly shrinks the non-parametric fitted function into a non-linear function space while allowing for fits outside of this space when the data suggest alternative shapes. This approach extends existing functional shrinkage approaches into linear subspaces [1] to shrinkage into non-linear function spaces using a Taylor series expansion and corresponding updating of non-linear parameters. We demonstrate this general approach on the Hill model, a popular, biologically motivated model, and show that shrinkage into combined function spaces, i.e., where one has two or more non-linear functions a priori, is straightforward. We demonstrate this approach through synthetic and real data.

[1] Shin, M., Bhattacharya, A., & Johnson, V. E. (2020). Functional horseshoe priors for subspace shrinkage. *Journal of the American Statistical Association*, 115(532), 1784-1797.

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