

## A Time-Varying and Non-Stationary Convolution Spectral Mixture Kernel for Gaussian Process

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**Abstract :** Gaussian process (GP) with spectral mixture (SM) kernel demonstrates flexible non-parametric Bayesian learning ability in modeling unknown function. In this work a novel time-varying and non-stationary convolution spectral mixture (TN-CSM) kernel with a significant enhancing of interpretability by using process convolution is introduced. A way decomposing the SM component into an auto-convolution of base SM component and parameterizing it to be input dependent is outlined. Smoothly, performing a convolution between two base SM component yields a novel structure of non-stationary SM component with much better generalized expression and interpretation. The TN-CSM perfectly allows compatibility with the stationary SM kernel in terms of kernel form and spectral base ignored and confused by previous non-stationary kernels. On synthetic and real-world datasets, experiments show the time-varying characteristics of hyper-parameters in TN-CSM and compare the learning performance of TN-CSM with popular and representative non-stationary GP.

**Keywords :** Gaussian process, spectral mixture, non-stationary, convolution

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