# Ongoing work on Inference Problems on Spectral Analysis in Spatial Datasets

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## 1. Overview

In contemporary scientific research, the analysis of intricate patterns and configurations within spatial and time series data sets is imperative. Building on the work of Jentsch and Pauly (2015), we have developed a non-parametric test grounded in the asymptotic theory of spectral density estimates. This test efficiently assesses whether two or more processes exhibit similar spatial dependence structures within the same region, subject to certain assumptions. Our approach introduces a computationally efficient and interpretable test statistic, along with a derived asymptotic null distribution. Additionally, we have proposed a novel information criterion for spatial models, establishing its asymptotic distribution under specific conditions. This criterion proves valuable in spatial model selection, providing insights into goodness of fit through the asymptotic distribution of model selection criteria.

We primarily worked on regular set up, and under some regularity assumptions, we generalized the asymptotic distribution of the test statistic, which is a spatial extension of Jentsch and Pauly (2015). We are finding the expression of asymptotic mean and variance. But, due to slow convergence of $L_2$ type test statistic, we relied on a data driven jackknife type resampling to replace the population asymptotic quantile by data driven quantile and defined the test in a fully data driven way. Han (2021) proposes a test for a similar kind of problem, which is completely based on only the mean behavior. But in the spatial setting, most of the information lies in the covariance pattern, so only mean behavior analysis is not enough, one has to carefully check the covariance pattern also, that's why we relied on spectral analysis. We also got that the size of the test is $\alpha$ asymptotically. Then we reported Confidence interval of the mean of the process based on spectral density under the assumptions of Deb, Pourahmadi and Wu (2017) along with Jentsch and Pauly (2015).

We then defined an information criteria which can be used for model selection based on this test. We also derived the asymptotic distribution of the information criteria.

We are now performing simulation studies to get the idea about power of the test and power of the information criteria, which is under work as of now. Then we described several application of our testing procedure, one of which is mindblowing, nonparametric separability testing based on our test and other one test and some developing theory (being developed by us).

## References

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