[P21] Statistical Mechanics of Time-series Analysis for Meteorological Data via the Ising Model under Random Field

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Based on Bayesian inference using the expected a posterior (EAP) estimation regarded as statistical mechanics of the Ising model under random field [1], we forecast time evolution of meteorological variables, such as temperature, at a target point by making use of a set of time-series of meteorological variables which are similar to that of the target point selected due to the metric multi-dimensional scaling (metric-MDS) [2]. Using numerical simulation for a set of temperatures at 23 sampling points in Japan from 1st July to 31th July, 2011, we find that the present method succeeds in predicting time-series of temperature at the target point (Maebashi) by using the time-series of temperatures both at the target point and 5 sampling points (Kanuma, Kiryu, Isezaki, Kamisatomi) appropriately selected due to the metric-MDS, if we control fluctuations around the MAP solution appropriately tuning hyper-parameters corresponding to the coupling constant and the external field of the Ising model. Also, we find that the time-series of temperature can be predicted accurately by utilizing those 5 time-series of temperatures selected above, even if we do not use information on the target data.
In addition, similar results are obtained by the replica theory using the infinite-range model. Then, we apply this strategy for power demand prediction in the National Institute of Technology, Gunma College as a typical small-scale organization [3].

References

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