

HIRATA LAB.

[Revealing Hidden Patterns within Time Series Data]

Mathematical Engineering for Complex Social Systems in Future

Nonlinear Time Series Analysis

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Nonlinear Time Series Analysis and its Cross-disciplinary Applications

This laboratory develops methods for nonlinear time series analysis and applies the methods to real datasets of important problems including ones from lives, brains, earthquakes, weather, renewable energy, and foreign exchange markets. Our current main focusses include (i) developing methods for analyzing point process data, where events are observed at irregular times, (ii) understanding high-dimensional time series in intuitive ways, and (iii) probabilistic forecasts for time series data.

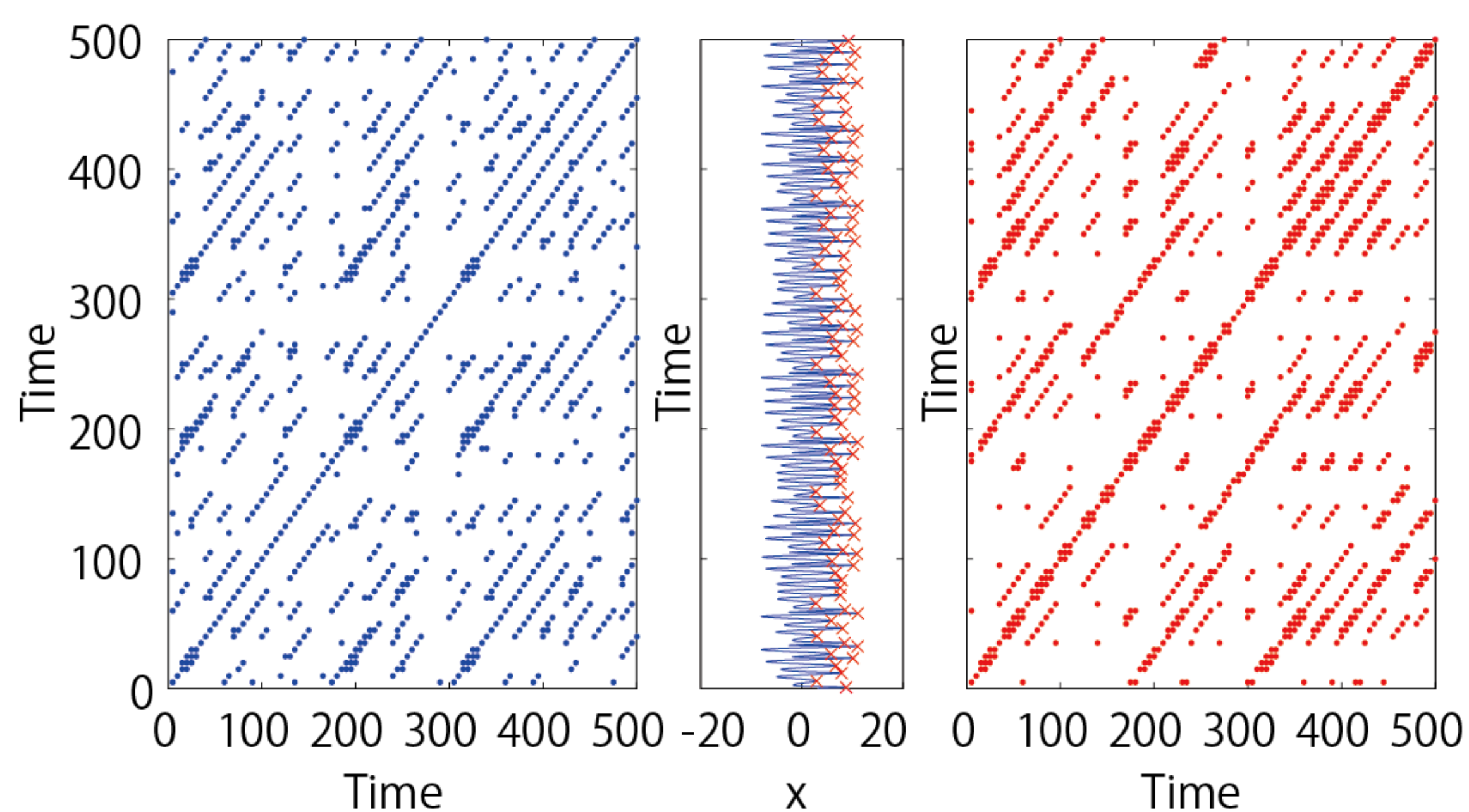


Fig. 1. Recurrence plot (left) of the original time series (middle, blue line) generated From Rössler system and recurrence plot (right) obtained from Its local maxima series (middle, red crosses) using the distance for marked point processes. (ref: Suzuki, Hirata, and Aihara, Int. J. Bifurcat. Chaos (2010))

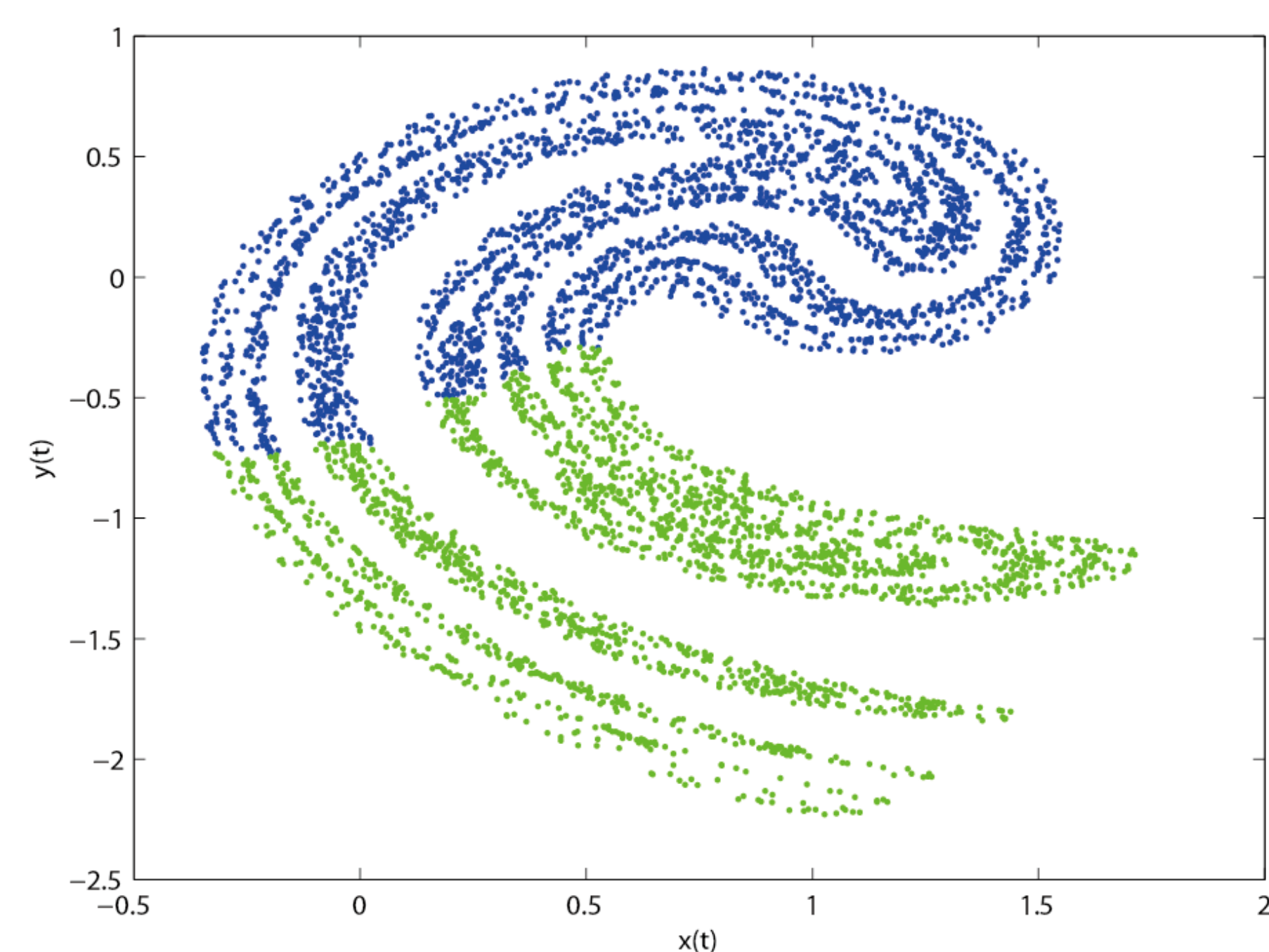


Fig. 2. Noisy Ikeda map partitioned into two in such a way that the information related to dynamics is maximally preserved. (ref: Hirata and Aihara, Eur. Phys. J. Spec. Top. (2013))

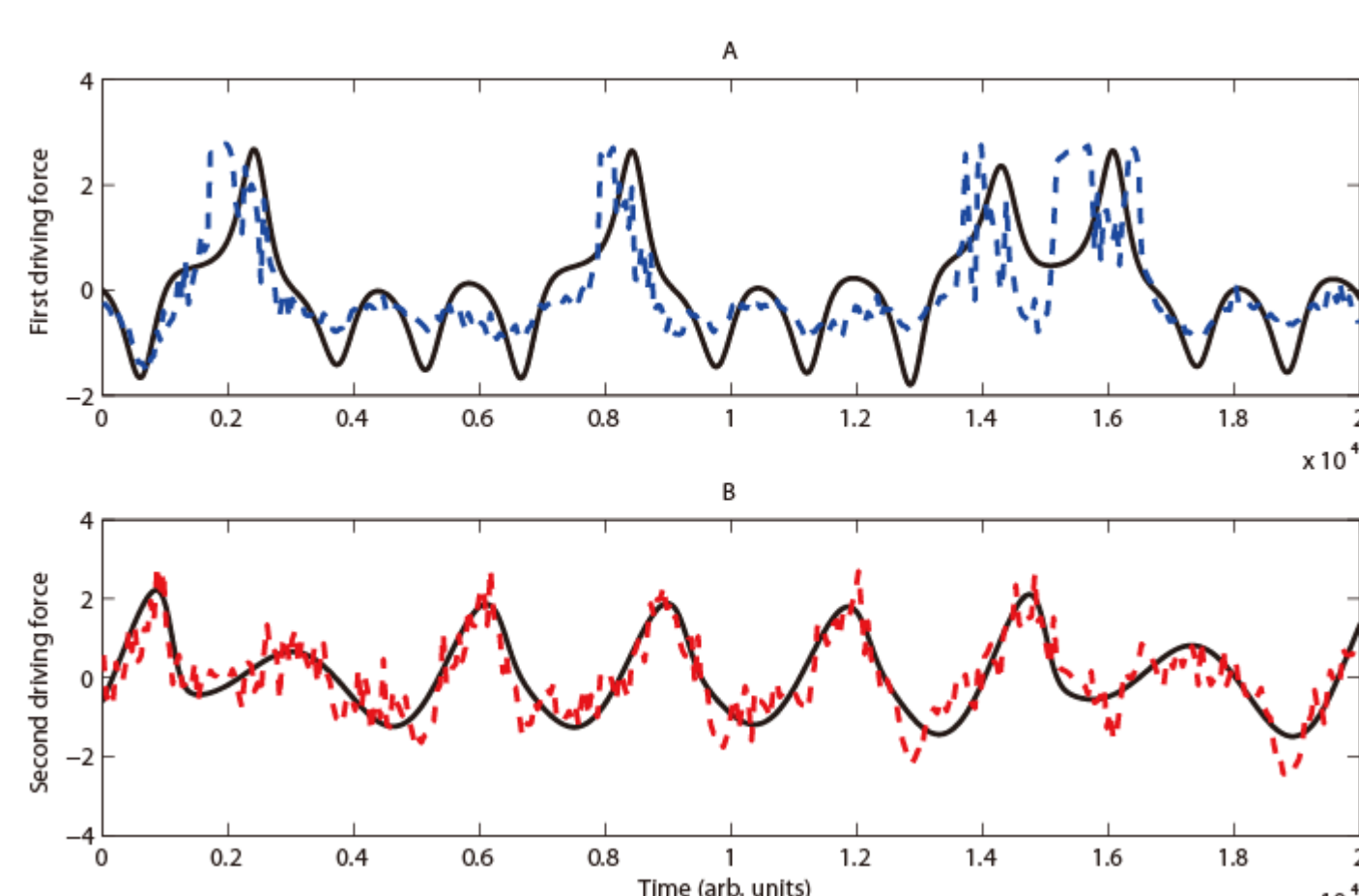


Fig. 3. Reconstruction of slow driving forces. Here we input the Lorenz model (top, solid line) and the Rössler model (bottom, solid line) to the Hénon map. Then we reconstructed these driving forces from the observations (dashed lines) of the Hénon map. (ref. Hirata, Horai, and Aihara, Eur. Phys. J. Spec. Top. (2008))

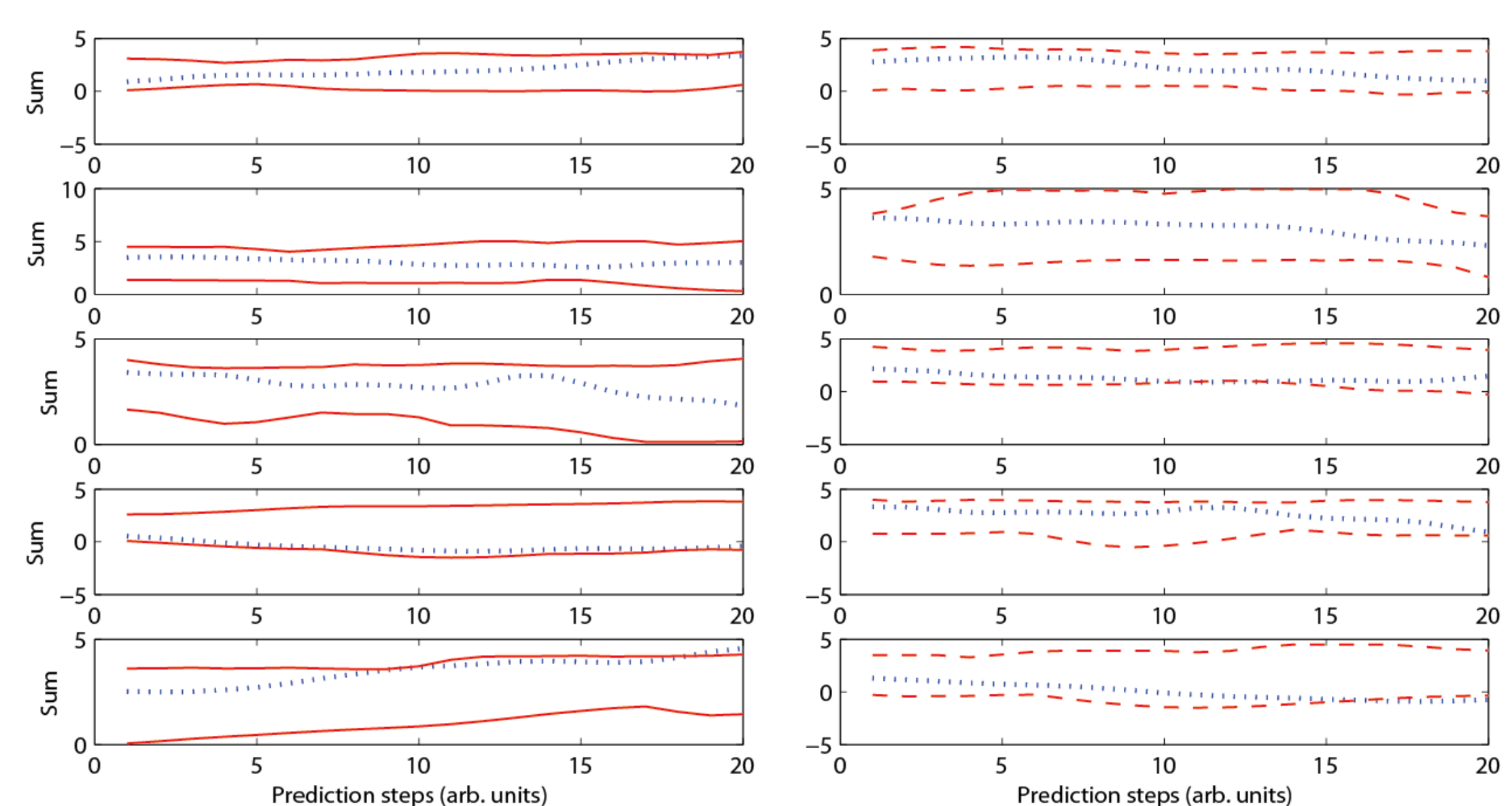


Fig. 4. Time series prediction with confidence intervals: Actual values (blue dotted lines) and 96% confidence interval (red lines) (ref: Hirata et al., Renew. Energy (2014))