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Extracting strong measurement noise from stochastic series: applications to empirical data

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It is a big challenge in the analysis of experimental data to disentangle the unavoidable measurement noise from the intrinsic dynamical noise. Here we present a general operational method to extract measurement noise from stochastic time series, even in the case when the amplitudes of measurement noise and uncontaminated signal are of the same order of magnitude. Our approach is based on a recently developed method for a nonparametric reconstruction of Langevin processes. Minimizing a proper non-negative function the procedure is able to correctly extract strong measurement noise and to estimate drift and diffusion coefficients in the Langevin equation describing the evolution of the original uncorrupted signal. As input, the algorithm uses only the two first conditional moments extracted directly from the stochastic series and is therefore suitable for a broad panoply of different signals. To demonstrate the power of the method we apply the algorithm to synthetic as well as climatological measurement data, namely the daily North Atlantic Oscillation index, shedding new light on the discussion of the nature of its underlying physical processes.

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