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Phase dynamics of coupled oscillators reconstructed from data MICHAEL ROSENBLUM, Dept. of Physics and Astronomy, University of Potsdam, Germany, BJOERN KRALEMANN, Christian-Albrechts-Universitaet zu Kiel, Germany, ARKADY PIKOVSKY, Dept. of Physics and Astronomy, University of Potsdam, Germany — We present a technique for invariant reconstruction of the phase dynamics equations for coupled oscillators from data. The invariant description is achieved by means of a transformation of phase estimates (protophases) obtained from general scalar observables to genuine phases. Staring from the bivariate data, we obtain the coupling functions in terms of these phases. We discuss the importance of the protophase-to-phase transformation for characterization of strength and directionality of interaction. To illustrate the technique we analyse the cardio-respiratory interaction on healthy humans. Our invariant approach is confirmed by high similarity of the coupling functions obtained from different observables of the cardiac system. Next, we generalize the technique to cover the case of small networks of coupled periodic units. We use the partial norms of the reconstructed coupling functions to quantify directed coupling between the oscillators. We illustrate the method by different network motifs for three coupled oscillators. We also discuss nonlinear effects in coupling.

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