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Phase synchronization and recurrence quantitative analysis of stick slip acoustic data sets

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In the present research we have investigated dynamical properties of acoustic emission time series. Laboratory acoustic emission data were obtained during stick-slip experiments with superimposed periodic perturbations with variable amplitude (from 0 to 1000 V). Slip events were recorded as acoustic emission bursts.

To investigate possible synchronization effects of external forcing the instantaneous phases of the analysed data sets were calculated based on the Hilbert transform and analytic signal concept. Additionally in order to test in a quantitative manner possible dynamical changes related to synchronization of acoustic emission data recurrence quantification analysis (RQA) method was used.

It was shown that phase evolution of acoustic emission data sets becomes less slanted when external forcing increase. This mean that extent of synchronization increases.

Dynamical character of acoustic emission also is changed at synchronization. It was shown that recurrence rate and determinism, main RQA characteristics of process coherency, increase under conditions close to synchronization.