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Network and Dynamical System Analysis of a Granular Stick-Slip Experiment[1] DAVID W. WALKER, ANTOINETTE TORDESILLAS, University of Melbourne, M. SMALL, Hong Kong Polytechnic University, R. P. BEHRINGER, Duke University — We describe analysis of stick-slip behavior in a granular material under shear from a slider that is pulled across the granular surface. We extend previous statistical analysis, focusing on size distributions of failure events by applying nonlinear time series analysis, including surrogate data, and complex network methods. Local dimension measures suggest a robust evolution law of stick-slip dynamics needs at least 4 to 6 degrees of freedom. Surrogate methods indicate that individual stick-slip events may contain more complex nonlinear determinism periodic dynamics, although models with periodic dynamics are adequate for some cases. Within each stick-slip "cycle", we found evidence of nonlinear determinism but no long term memory across cycles. Representing the observed time series as a complex network, however, revealed that despite no evidence for long term dynamical correlations between distinct stick-slip events there is consistency in the structure of individual subnetworks associated with the onset of each slip event, possibly reflecting a single driving mechanism of failure, i.e. dynamics of force chains. When the data is representated as a complex network, it appears to present a new stratification of system dynamics with a previously unreported ranking, or genus,

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