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Process, Pattern and Prediction in Avalanche Models of Driven Threshold Systems, with Applications to Earthquakes JOHN RUNDLE, JAMES HOLLIDAY, Univ. of California, Davis, WILLIAM KLEIN, Boston Univ., PAUL RUNDLE, Harvey Mudd College, DONALD TURCOTTE, Univ. of California, Davis — Forecasting the onset and severity of extreme avalanche events in driven threshold systems, including neural networks, earthquakes, charge density waves, sandpiles and magnetic de-pinning transitions is complicated by the inability to directly observe many of the fundamental dynamical processes, together with the wide range of scales that characterize these systems. With respect to earthquakes, the economic damages from the most severe of these events amount to annualized economic costs of many billions of dollars, and are also associated with great suffering associated with the loss of many thousands of human lives each year. In systems such as these, we can only observe the space-time *patterns* of extreme events, the largest earthquakes. Using these space-time patterns, and whatever is known about the dynamics of these high-dimensional nonlinear earth systems, it often possible to construct numerical simulations that can be used to make *predictions* about the future space-time evolution of the system and the possible occurrence of extreme events. The accuracy of these predictions and forecasts is limited by the proximity and similarity of the model trajectory through state space, to that of the actual system. In this talk we summarize current methods that are being developed based on space-time pattern recognition techniques, together with numerical simulation of the underlying dynamics. We also discuss how these techniques may be tested, together with the current results.

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