Probing Fault Physics Applying Machine Learning

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We analyze large amounts of continuous seismic data with machine learning, with the goal of identifying hidden signals connected to earthquake cycles. In the laboratory, we find that continuous seismic waves are imprinted with fundamental information regarding the state of faults. Statistics of low-amplitude, noise-like signals can be used to estimate fault friction, displacement, and predict upcoming failure with great accuracy. These results hold true for a broad spectrum of slip behaviors. Our first application to Earth data in the Cascadia subduction zone shows that a similar approach can be used to infer slow slip fault displacement (estimated by surface GPS) from continuous seismic waves. Because the signal identified is very similar to results in the laboratory, the underlying physics may scale from the laboratory to Earth.