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Slow frictional waves KOUSHIK VISWANATHAN, Purdue University, NARAYAN SUNDARAM, Indian Institute of Science, SRINIVASAN CHANDRASEKAR, Purdue University — Stick-slip, manifest as intermittent tangential motion between two dry solid surfaces, is a friction instability that governs diverse phenomena from automobile brake squeals to earthquakes. We show, using high-speed in situ imaging of an adhesive polymer interface, that low velocity stick–slip is fundamentally of three kinds, corresponding to passage of three different surface waves — separation pulses, slip pulses and the well–known Schallamach waves. These waves, traveling much slower than elastic waves, have clear distinguishing properties. Separation pulses and Schallamach waves involve local interface separation, and propagate in opposite directions while slip pulses are characterized by a sharp stress front and do not display any interface detachment. A change in the stick-slip mode from separation to slip pulse is effected simply by increasing the normal force. Together, these three waves constitute all possible stick-slip modes in adhesive friction and are shown to have direct analogues in muscular locomotory waves in soft bodied invertebrates. A theory for slow wave propagation is also presented which is capable of explaining the attendant interface displacements, velocities and stresses.

Koushik Viswanathan
Purdue University

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