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Stress dynamics of a 2D dense granular system near shear jamming[1] JIE REN, JOSHUA DIJKSMAN, ROBERT BEHRINGER, Duke University — We study the dynamics of pressure and shear stress in a frictional 2D dense granular system using a novel apparatus that can provide fixed-volume shear without generating inhomogeneities. Under increasing shear strain, the system's pressure shows a strong increase with strain, characterized by a "Reynolds coefficient," $R = d^2P/d\gamma^2$. R depends only on packing fraction ϕ, and shows a strong increase as ϕ approaches ϕ_J from below. In the meantime, the system's shear stress shows a non-monotonic behavior with increasing strain. It first increases with strain as the system is in "fragile" states and builds up long force chains along the compression direction. After a certain amount of strain, force chains along the dilation direction starts to build up, and the system transfers into a "shear-jammed" state and the shear stress starts to decrease with strain. Under oscillatory shear, both pressure and shear stress show limit-cycle behavior and reach steady states after many cycles. However, the limit cycles of pressure and shear stress are very different: the pressure exhibits a hysteresis-free parabolic curve, while the shear stress exhibits a strongly hysteretic loop.

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Jie Ren
Duke University

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