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Controllable jamming of amorphous granular materials applied to robotics[1] ERIC BROWN, RODENBERG RODENBERG, The University of Chicago, JOHN AMEND, HOD LIPSON, Cornell University, ANNAN MOZEIKA, ERIK STELTZ, iRobot G&I Research, MITCHELL ZAKIN, DARPA, HEINRICH JAEGER, The University of Chicago — We demonstrate the practicality of using a controlled jamming transition in an amorphous mass of granular material for applications to robotic gripping, and how the gripping capabilities depend on the properties of the jammed state. A mass of granular material contained in a flexible membrane in an unjammed state flows and conforms to almost any object it is pressed against. Upon application of a vacuum, the external pressure on the membrane jams the granular mass with a volumetric contraction $< 1\%$, allowing it to pinch the object. By measuring the holding force on a test sphere at different levels of envelopment, we show that three mechanisms contribute to the holding force: friction, suction, and interlocking. We use a solid mechanics model to relate the holding force from each mechanism to the measured stress response of jammed granular materials to compressional, extensional, and bending strains. This opens up new possibilities for the design of simple systems that excel at gripping objects of arbitrary shape.

[1]E. Brown et al., PNAS 107(43) (2010). Videos: http://ccsl.mae.cornell.edu/jamming_gripper

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