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Vibrational modes of jammed and unjammed packings THIBAULT BERTRAND, Department of Mechanical Engineering and Materials Science, Yale University, CARL F. SCHRECK, Department of Physics, Yale University, COREY S. O'HERN, Department of Mechanical Engineering and Materials Science, Yale University, MARK D. SHATTUCK, Benjamin Levich Institute and Department of Physics, City College of the City University of New York — We showed previously that granular packings composed of frictionless particles with repulsive contact interactions are strongly nonharmonic. Weakly vibrated packings possess well-defined average positions that differ from those of the unvibrated packing and other nearby static packings, and when excited along a single vibrational mode from the dynamical matrix energy quickly leaks to other modes during vibration due to contact breaking. We now measure the displacement correlation matrix for weakly vibrated systems and the velocity autocorrelation function averaged over fluctuations to extract the associated density of vibrational modes. We find that there is an increase in the number of low-frequency eigenmodes of the displacement matrix compared to that for the dynamical matrix in linear response, and these modes provide a more accurate description of the dynamics. The new set of modes from the displacement correlation matrix persists over several orders of magnitude in the input energy of the vibrations. Futhermore, the new vibrational modes are insensitive to pressure, i.e. packings prepared above and below jamming yield the same set of vibrational modes. We also perform vibration experiments as a function of amplitude and frequency, and compare our findings.

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