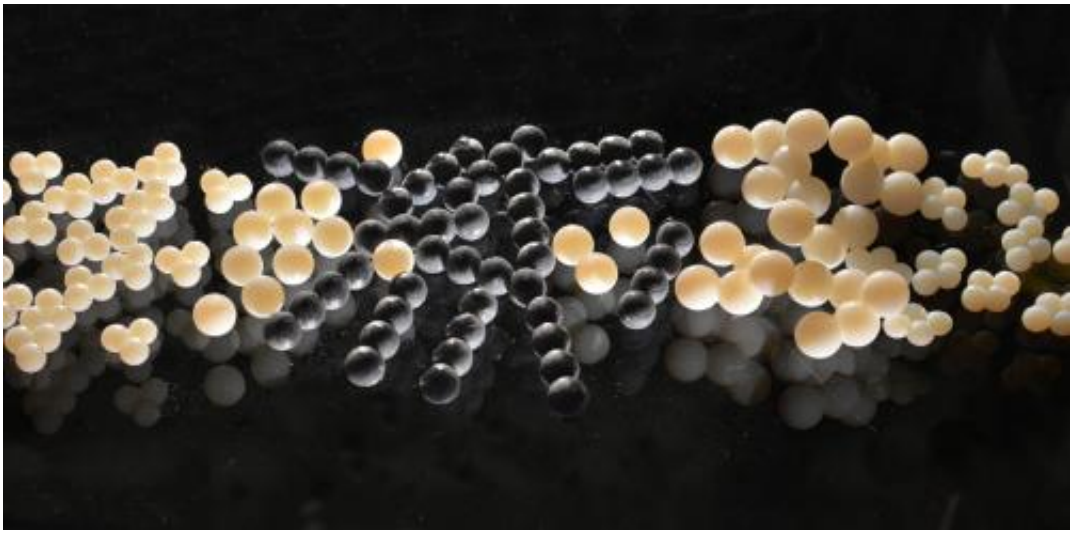
Using 3-D printing to turn computer models into reality (w/ video)

March 19 2013, by Steve Koppes



Graduate student Marc Miskin manufactured granular materials of various shapes in a 3D printer to test their aggregate properties when jammed into a confined space. Credit: Robert Kozloff/University of Chicago

Prof. Heinrich Jaeger's research group examines materials and phenomena that appear simple at the surface, but which reveal tremendous complexity upon close examination. One such phenomenon is jamming, in which aggregates of randomly placed particles, including spheres or more complicated shapes, or even molecules, transition from fluid-like to solid-like behavior.

Jamming lends itself to soft robotics, in addition to other applications as

explored in a workshop at the University of Chicago last October. In recent computer simulations and experiments, Jaeger, the William J. Friedman & Alicia Townsend Professor in Physics, and graduate student Marc Miskin investigate another aspect of jamming. They analyzed how the properties of a jammed material can be tuned by changing the shape of the constituent particles. Their results on "Adapting granular materials through artificial evolution" appeared Jan. 20 as an Advance Online Publication in *Nature Materials*.

Miskin and Jaeger addressed a daunting question in their research: Given a design goal for the jammed aggregate, for example to have it as stiff or as soft as possible in response to an applied force, what particle shape will best produce the desired outcome? For this complex optimization problem, they faced an infinite variety of shapes to choose from. So Miskin employed a computer algorithm—referred to as an "evolutionary optimization" in the accompanying video—to answer this question.

The computer designed particles by starting from a random shape, and then iteratively altered its configuration, at each stage performing a series of simulations that tested how close the performance approximated the stated goal. Once an optimal shape was identified, Miskin then manufactured a large number of copies with the lab's 3D printer for testing in a viselike squeezing apparatus to verify his algorithm's predictions.

More information: www.nature.com/nmat/journal/va … t/full/nmat3543.html

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