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Defect-controlled buckling of depressurized elastic shells ANNA LEE, JOEL MARTHELOT, FRANCISCO LPEZ JIMNEZ, PIERRE-THOMAS BRUN, PEDRO REIS, Massachusetts Institute of Technology — We revisit the classic problem of buckling of spherical elastic shells under pressure loading, with an emphasis on determining the role that engineered imperfections have on the critical buckling pressure. Since the 1960s numerous theoretical and computational studies have addressed this canonical problem in engineering mechanics, but there is a striking lack of precision experiments to corroborate these predictions. We perform an experimental investigation where thin shells of nearly uniform thickness are fabricated by the coating of hemispherical molds with a polymer solution, which upon curing yields the elastic structure. Moreover, our manufacturing technique allows us to introduce a single dimple-like defect with controllable geometric properties. By systematically varying the amplitude of this defect (smaller than the thickness of the shell) we study the effect that these imperfections have on the buckling strength of our spherical shells. Small deviations from the spherical geometry result in large reductions in the buckling pressure and our experimental results agree well with the existing theories. We then perform a broader exploration for other classes of defects, for which theoretical predictions are yet to be developed.

Anna Lee
Massachusetts Institute of Technology

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