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Sinusoidal to helical buckling of an elastic rod under a cylindrical constraint TIANXIANG SU, Harvard University, JAMES MILLER, ARNAUD LAZARUS, Massachusetts Institute of Technology, NATHAN WICKS, JAHIR PABON, Schlumberger-Doll Research, KATIA BERTOLDI, Harvard University, PEDRO REIS, Massachusetts Institute of Technology — We investigate the buckling and post-buckling behavior of an elastic rod loaded under cylindrical constraint. Our precision desktop-scale experiments comprise of axially compressing a hyperelastic rod inside a transparent acrylic pipe. These experiments are also modeled using a discrete elastic rod simulation that includes frictional effects. Under imposed displacement, the initially straight rod first buckles into a sinusoidal mode and eventually undergoes a secondary instability into a helical buckling regime. The buckling and post-buckling behavior is found to be highly dependent on the systems' geometry, in particularly the aspect ratio of the rod to pipe diameter. We quantify the wavelength and pitch of the periodic patterns through direct digital imaging and record the reaction forces at both ends of the pipe. The observed behavior is rationalized through scaling arguments and captured by numerical simulations.

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