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Helical instability in pulsatile pipe flow.[1] ATUL VARSHNEY, Institute of Science and Technology Austria, 3400 Klosterneuburg, Austria, DUO XU, MARC AVILA, Center of Applied Space Technology and Microgravity, University of Bremen, 28359 Bremen, Germany, BJORN HOF, Institute of Science and Technology Austria, 3400 Klosterneuburg, Austria — Fluid flow when subjected to periodic velocity modulations (e.g. cardiovascular flows) exhibit hydrodynamic instabilities and turbulence depending on frequency and amplitude of pulsation. Fluctuating shear stresses and disordered flow are responsible for cellular dysfunction in blood vessels, leading to the development of atherosclerotic lesions. We identify a nonlinear instability mechanism for pulsating pipe flow that gives rise to bursts of turbulence at low flow rates. Geometrical distortions of small, yet finite, amplitude are found to excite a state consisting of helical vortices during flow deceleration. The resulting flow pattern grows rapidly in magnitude, breaks down into turbulence, and eventually returns to laminar when the flow accelerates. This scenario causes shear stress fluctuations and flow reversal during each pulsation cycle. Further, we track the helical instability in a broad parameter space of Reynolds number and Womersley number, and towards nearly oscillatory flows, i.e. flows with small or no mean flow component.

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