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Imperfection Sensitivity of Circular Arch's Non-Linear Modes

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The paper addresses the imperfection sensitivity of non-linear vibration modes of moderately low and slender circular arches. Such structures may undergo unstable symmetric bifurcation prior to snap-through, under static uniform radial loading. Such instability corresponds to a buckling load that happens to be imperfection sensitive. A small imperfection may drastically cause the reduction of the arch's critical load and, consequently, of its stiffness and vibration properties. Two finite-element procedures developed by the authors were employed, based on the invariant manifold and the multiple-scale techniques. A range of geometric, static loading and imperfection parameters are considered in the numerical simulations, so as to allow for comparison among different levels of description of the free-vibration properties of these structures, such as the linear modes, the non-linear modes about the undeformed configuration, and the non-linear modes about the equilibrium configuration of both perfect and imperfect systems.

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