Shells containing flowing fluids are widely used in engineering applications, and they are subject to manifold excitations of different kinds, including flow excitations. Usually these shells are made as thin as possible for weight and cost economy; therefore, they are quite fragile, and their response to such excitations is of great interest. The response of a shell conveying fluid to harmonic excitation, in the spectral neighbourhood of one of the lowest natural frequencies, is investigated for different flow velocities. The theoretical model has been developed using the Donnell theory retaining in-plane inertia. Linear potential flow theory is applied to describe the fluid-structure interaction, and the steady viscous effects are added to take into account flow viscosity. For different amplitudes and frequencies of the excitation and for different flow velocities, the following are investigated numerically: (i) periodic response of the system; (ii) unsteady and stochastic motion; (iii) loss of stability by jumps to bifurcated branches. The effect of the flow velocity on the nonlinear periodic response of the system has also been investigated. Poincaré maps, bifurcation diagrams and Lyapunov exponents have been used to study the unsteady and stochastic dynamics of the system. Amplitude-modulated motions, multi-periodic solutions, chaotic responses, cascades of bifurcations as the route to chaos and the so-called “blue sky catastrophe” phenomenon have all been observed for different values of the system parameters.

REFERENCES