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Chaotic Advection by Two Helical Vortices[1] ALEJANDRO ESPINOSA RAMIREZ, OSCAR VELASCO FUENTES, CICESE, Ensenada, Mexico
— We studied numerically the fluid motion induced by two equal helical vortices immersed in an inviscid, incompressible, and unbounded fluid. The vortices, being thin tubes of uniform vorticity on their circular cross section, move steadily when they are symmetric, i.e., when they occupy diametrically opposite points of the imaginary cylinder where they are coiled. If the initial configuration is slightly asymmetric, the vortices move with varying linear and angular velocities, performing a periodic motion analogous to the leapfrogging of ring vortices. We analyzed the vortex motion, as well as the associated fluid advection, as a function of the initial asymmetry and the vortices' pitch and core radius. We focused on two of the four regimes previously identified for the symmetric, steady case (Velasco Fuentes, J.F.M. 842, R2, 2018), namely, large-pitch and small-pitch vortices of relatively large core (within the thin-tube approximation). We found that the initial asymmetry slightly reduces the amount of fluid carried by large-pitch vortices, as regions of intense stirring gradually appear. In contrast, even the smallest asymmetry greatly reduces the amount of fluid carried by small-pitch vortices and produces large regions of intense stirring.

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