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A higher-order asymptotic formula for velocity of a viscous vortex pair YASUHIDE FUKUMOTO, Institute of Mathematics for Industry, Kyushu University, UMMU HABIBAH, Graduate School of Mathematics, Kyushu University — We establish a general formula for the traveling speed of a counter-rotating vortex pair, being valid for thick cores, moving in an incompressible fluid with and without viscosity. Two-dimensional motion of vortices with finite cores, interacting with each other, has been extensively studied both analytically and numerically. Mathematical methods and numerical schemes have been highly developed for dealing particularly with vortices of uniform vorticity, called vortex patches. In contrast, this is not the case with vortices with distributed vorticity. We extend, to a higher order, the method of matched asymptotic expansions developed by Ting and Tung (1965 Phys. Fluids Vol. 8 pp. 1039-1051). The solution of the Navier-Stokes equations is constructed in the form of a power series in a small parameter, the ratio of the core radius to the distance between the core centers. A correction due to the effect of finite thickness of the vortices to the traveling speed makes its appearance at the 5th order. We manipulate a tidy formula of this correction term for a general vorticity distribution at the leading order. An alternative route to reach the same formula is also sought. We devise a two-dimensional counterpart of Helmholtz-Lamb's formula which is applicable to vortex rings.

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