Analysis of slender bodies of revolution with curved-ground effect and waving-water effect

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The classical slender body theory is generalized to the problems of a slender body of revolution moving with an angle of attack, in very close proximity to curved-ground and waving-water surfaces. The flow problems are reduced to the two-dimensional flow problem of double, circular cylinders, which is then solved by the method of complex variables and Fourier series. The attractive force and pitching moment, and the lateral force and yawing moment acting on the body are derived in terms of integrals over the body length. For a horizontal translation of the body near the curved ground, the attractive force will increase as the body is brought closer to the ground or as the absolute value of the angle of attack increases, and a convex (concave) ground will strengthen (weaken) the ground effect. However, for a horizontal translation of the body near a waving-water surface, the periodic attractive force is nearly in phase with the wave height beneath the body's centre, and its amplitude increases with the relative velocity between the body and the water wave motion.