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Magnus effect near flat ground[1] CHIN-CHOU CHU, HSIN-HUA LEE, Institute of Applied Mechanics, National Taiwan University, CHIEN C. CHANG, Institute of Applied Mechanics and Center for Advanced Research in Theoretical Sciences, National Taiwan University — This research is aimed to conduct experimental and numerical analysis of the Magnus effect when a circular cylinder is approaching a flat ground. The Reynolds number is fixed at 2000. Normalized parameters include the translation-rotation speed ratio α, declining velocity ratio β (translation-downward), and the gap ratio, denoted by SG (=gap/D), where D=2cm is the diameter of the cylinder. The range of interest for α is from 0 to 0.2, and SG from 5 to 0.5, Three types of flow behaviors are identified according to the rotation of the cylinder: (i) non-rotating ($\alpha = 0$), (ii) rotating counterclockwise ($\alpha >0$) and (iii) rotating clockwise ($\alpha <0$). In the first case ($\alpha = 0$), the ground effect mitigates eddies behind the cylinder and leads to a higher lift and drag. In the second case ($\alpha >0$), as SG is decreasing, the lift and drag drops while the vortex shedding frequency increases. The vortex around the cylinder is alleviated by the ground effect, and the separation occurs at a lower portion behind the cylinder. In the last case ($\alpha <0$), as SG is decreasing, the drag increases while the vortex shedding frequency decreases. The vortex is strengthened by the ground effect, and the separation occurs at a higher location with the same reasoning. Further, stability analysis is applied to the three distinguished types of motion to examine their stability. In comparison, the phenomena of the flow patterns are consistent in both static and dynamic cases, yet the forces exerted on the cylinder are smaller in the dynamic cases.

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