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Limits of the potential flow model for obstacle detection using a lateral line AUDREY MAERTENS, MIT, GABRIEL WEYMOUTH, SMART, MICHAEL TRIANTAFYLLOU, MIT — Fish have a particular sensory system called lateral line through which they measure flow velocity and pressure gradient. Behavioral studies have shown that fish can detect and identify obstacles while gliding using this sensory system alone. Despite a widespread interest of the community in understanding and reproducing this capability, a realistic approach is still missing. Indeed, due to computational constraints, most attempts to date have used potential flow models. The present work aims at revealing the limits of the potential flow model in the case of a vehicle gliding by a cylinder. The understanding thus gained can be used to account for viscous effects in a computationally-efficient fashion. An improvement of the boundary data immersion method provides accurate pressure predictions at the Reynolds numbers considered ($500 < \mathrm{Re} < 10000$). It is shown how a potential flow-based obstacle detection algorithm fails at locating the cylinder at these Reynolds numbers. It is also shown that a panel method accounting for dynamically changing displacement thickness leads to accurate pressure prediction. This is a first step toward real-time pressure predictions for viscous flows which is needed for efficient obstacle detection and identification algorithms.

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