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Title: Reduction of Wave Resistance of Displacement Vessels by Waterline Parabolization

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Abstract: Waterline parabolization is a method to reduce the wave resistance of a displacement type hull with a parallel mid-body by adding amidships bulbs to the hull. Tow tank tests of the optimized bulbs at ITU confirmed that significant reductions in total resistance were obtained. This paper describes the use of a nonlinear optimization technique developed at the University of British Columbia (UBC) and tank testing at Istanbul Technical University (ITU) to find the optimum shape and location of midship bulbs as well as midship bulbs and a bow bulb together. Tow-tank tests at UBC and ITU have shown that mid-ship bulbs can provide significant reductions in total resistance. The study validated the use of the technique both constraining the displacement and when only constraining the draft (retrofit). The optimization algorithm considers only wave resistance which is calculated with a Dawson's method type program; TRAWSON. In this study a RO/RO ferry hull is used as the baseline hull form. The tank tests revealed that the bulb location and geometry identified as the optimum, at Froude number $F_n = 0.33$, by the optimization program achieved a reduction in total resistance of 15 percent at constant displacement and retrofit applications.

Keywords: Ship resistance; Optimization; Amidshipsbulbs; Ferry; Bowbulbs.