FLUID STRUCTURE INTERACTIONS RESEARCH GROUP

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The Effect of Flexibility on the Design and Performance of Inflatable Boats, plus Environmental Considerations

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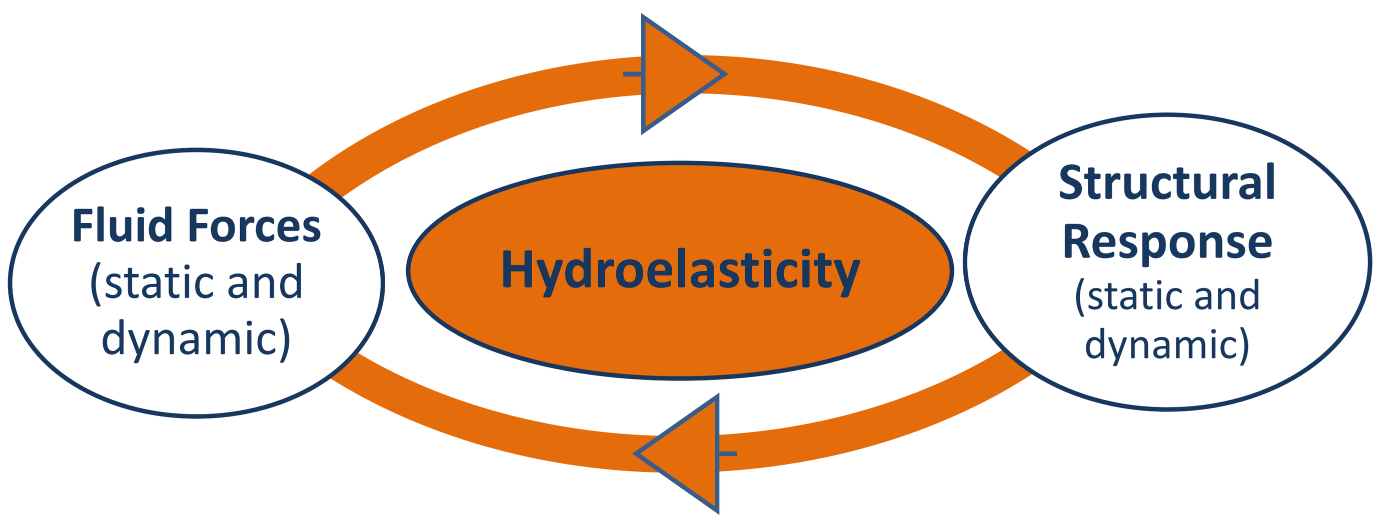
1. Introduction

This project is supported by the Royal National Lifeboat Institute (RNLI) who design, built and maintain the largest fleet of rigid inflatable boats (RIBs) and inflatable boats (IBs) in the UK. This project will focus on the vessels used in littoral waters, primarily the D-class inshore inflatable lifeboat known as the Inshore Boat 1 (IB1). Currently, there is relatively little scientific understanding of the performance of a RIB and their design is usually based on the experience of the designer. There is considerably less understanding of the performance of an IB. Experiments in the performance of RIBs includes; Haiping et al. (2005); Townsend et al. (2008a); Townsend et al. (2008b) and of a IB includes; Dand et al. (2008). A computational model of a RIB has been constructed by Lewis et al. (2006). However, none have fully explain the performance or hydroelasticity that these boat exhibit.

Anecdotal evidence has shown that the flexibility of an IB improves it performance, especially in waves. Therefore the focus of this project is to scientifically prove how and why the flexibility enhances performance. Then presenting the results in the form of design guidelines for the RNLI when they redesign their inshore lifeboat (IB1).

This project is in effect studying hydroelasticity with highly deformable structures but this cannot be performed until there is a greater understanding of the hydrodynamics and the structural stiffness of RIBs and IBs.



2. Aims

a) Investigate the structural stiffness by studying the 3 types of structures separately: the composite sandwich panel deck; the inflatable fabric sponsons and keel; and the boundary tensioned fabric hull. Then link them together to investigate the structural stiffness of the boat as a whole. Both experimental and computational methods will be used.

b) Explore the fluid forces acting on the boat, both hydrostatic and unsteady hydrodynamic. Computationally model: the pressure distribution along the hull, sponsons and keel; the individual drag components; and the seakeeping performance in terms of the motions of the boat. Then compare these to experimental results.

c) Examine the effect of hydroelasticity by iterating between the hydrodynamic model and the structural stiffness model. Then compare this to experimental results.

d) Consider the environmental noise, both air- and water-borne, by measuring it (using ISO 14509) and find reduction strategies.

e) Investigate the relationship between water depth and boat speed to minimise wave wash generation.

3. Differences between a conventional planing crafts (CPC) and the IB1

Right: Underwater image of the hull distortion at 19 knots, CPC hull's do not distort [Dand et al. (2008)]

Left: shows the spray produced by the IB1, CPC have a chine to cleanly separate the spray but the spray on the IB1 adheres to the sponson [Dand (2003)]

Right: shows the 4 deck parts of the IB1, CPC has 1 rigid deck.

4. Experimental Results

So far an initial experiment has been performed to investigate the structural stiffness of the IB1 by loading the boat under various loading conditions and measuring the change in vertical deflection, length and width. The results showed that the majority of the flexibility in the vertical direction is due to the deck joints and that the length and sponson width did change. The change in sponson width will result in a change in hull fabric tension, altering the hull distortion.

5. Conclusion/Further Work

It can be concluded that this project plans to examine many areas of novel research and then to couple them together to achieve a greater understand of the design and performance of an inflatable boat.
The future work required for the completion of this project can be seen through the aims of this project. To the author's knowledge this is the first research project into the hydroelasticity of planing crafts with highly deformable hulls. This means that a methodology for the project cannot be fully planned as many questions will be answered as the project progresses.

5. References

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