Hard top airfoil system

Background

Hydrofoiling is starting to become popular within sailing, and the power boats are gradually catching on the technology race towards more efficient and smooth opportunities provided by foiling. Since the electrification of a powerboat does not come close to the energy density and range of a combustion engine, there are basically three paths to choose from. 1- Accept a short range and charge more often. 2- Change from a fast-planning boat to a slow displacement boat. 3- Equip your powerboat of choice with a foiling system and try to reduce the weight as much as possible. Off course even a classic powerboat with a combustion engine will equally be efficient with a foil system, however, not as quiet, and smooth as an electric version. Foiling has the highest potential in saving energy for a marine vessel. The technology is, however, complicated, and usually requires a unique boat design. The energy saving in foiling comes from lifting the vessel out of the water, leaving only the wings and the thin legs in the water, which removes up to 80% of the friction. Historically there have also been boats with an airfoil, and even with classic wings. The idea with this is similar to a hydrofoil system – lift the boat out of the water as much as possible to reduce drag. Theoretically it should be possible to significantly reduce the energy need for a boat, by using a pair of airplane like wings – but is it possible to design a simple system, can it be controlled and cope with wind conditions, how much do you need to fly to reduce drag, can it be foldable and is it safe?

Tasks

1. Study the challenges in air foil design, and hydrofoiling – literature, papers, IP etc.
2. Design multiple large enough airfoil wing ideas built into a Hard top for a 30-foot powerboat
3. The wings must be foldable so that the hard top can function normally, however a new design is ok
4. Design a flexible propulsion system that includes a wing for steering, control and stability
5. Probably there's a need for fins and stabilizers in the water which also should be included
6. Design a flight control hardware system that controls the wings to compensate for wind etc.
7. Safety is key, and the study should also include an FMEA
8. Perform simulations on the final choice of design to be compared with the standard boat
9. Provide design sketches / simplified CAD-models and simulation results of the final candidate

Students

The project is in cooperation with Pennsylvania State University (Penn State). The project team will consist of two to four students from Chalmers and Penn state, respectively.

Industry contact

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Målgrupp

Maskinteknik (TKMAS), Teknisk fysik (TKTFY), Automation & mekatronik (TKAUT)

Gruppstorlek

2 - 4 studenter från Chalmers (och 2 - 4 studenter från Penn State)
(Projektet kan ej fördubblas)

References

Ekranoplan could be interesting to study since it's using the ground-effect which requires significantly smaller wings. Candela is a company that provides one of the most advanced hydro foiling systems on the market. True flight like the Airfish might require very large wings and be very complicated. Semi foiling might prove to be a good compromise and leave a small part of the boat in the water.