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## Simulation-driven Design of a Fast Monohull

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### ABSTRACT

A fast monohull has been designed and optimized within the European R&D project AutoPlan (www.auto-plan.net), using CAESES for parametric modeling and optimization coupled to Siemens Simcenter STAR-CCM+ for viscous free surface RANS simulations. The boat is a 9.5ton planing hull, featuring two tunneled propellers, conventional shafts, I-brackets and rudders. The optimizations were undertaken for thrust at design speed of 27.5kn. The boat was free to trim and rise, utilizing an overset grid along with free surface adaptive mesh refinement which gave a good comprise between high resolution and acceptable turn-around time per variant. Propulsion was taken into account via an actuator disc, balancing resistance and thrust for given propeller open-water characteristics. The geometry of the bare hull and the tunnel were varied during the optimizations, using fully-parametric models within CAESES, see Fig 1.

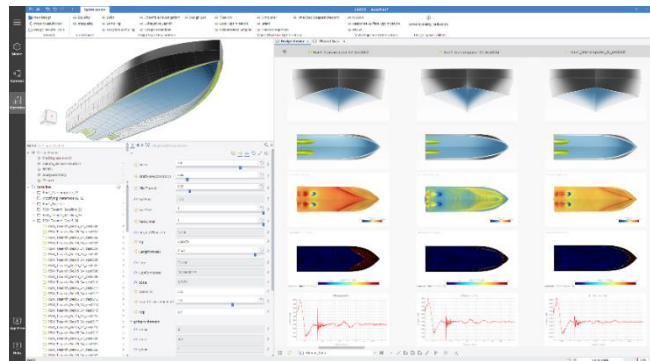


Fig. 1: Selected results from simulation-driven design of a fast monohull

A thorough comparison of numerical and experimental data was undertaken in order to ensure meaningful CFD results. The experiments were conducted with the high-speed carriage at TU Berlin's towing tank (formerly known as VWS), using a 3.5m fully-appended model manufactured at SVA Potsdam.

The optimizations undertaken comprised Design-of-Experiments, deterministic search strategies, surrogate modeling and various local and global strategies. Substantial improvements could be identified with variants being 15% more efficient than the original design (baseline) [1].

The contribution will discuss the parametric model, the CFD set-up and the various optimization approaches along with selected results. The boat is currently being built by the designing shipyard, UZMAR, in Turkey and full-scale trials will be run in April 2023, complementing the towing tank tests and giving further data for validation of the numerical simulations.

### REFERENCES

- [1] O. Ahmed, "Speeding-Up Simulation Driven Design for High-Speed Planing Boat", *Master Thesis*, École Centrale de Nantes, (2022).