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Scale-resolving simulation and particle image velocimetry validation of the flow around a marine propeller

Key words: Propeller; Numerical simulation; Scale-resolving simulation; PIV test

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Model of the entire propeller

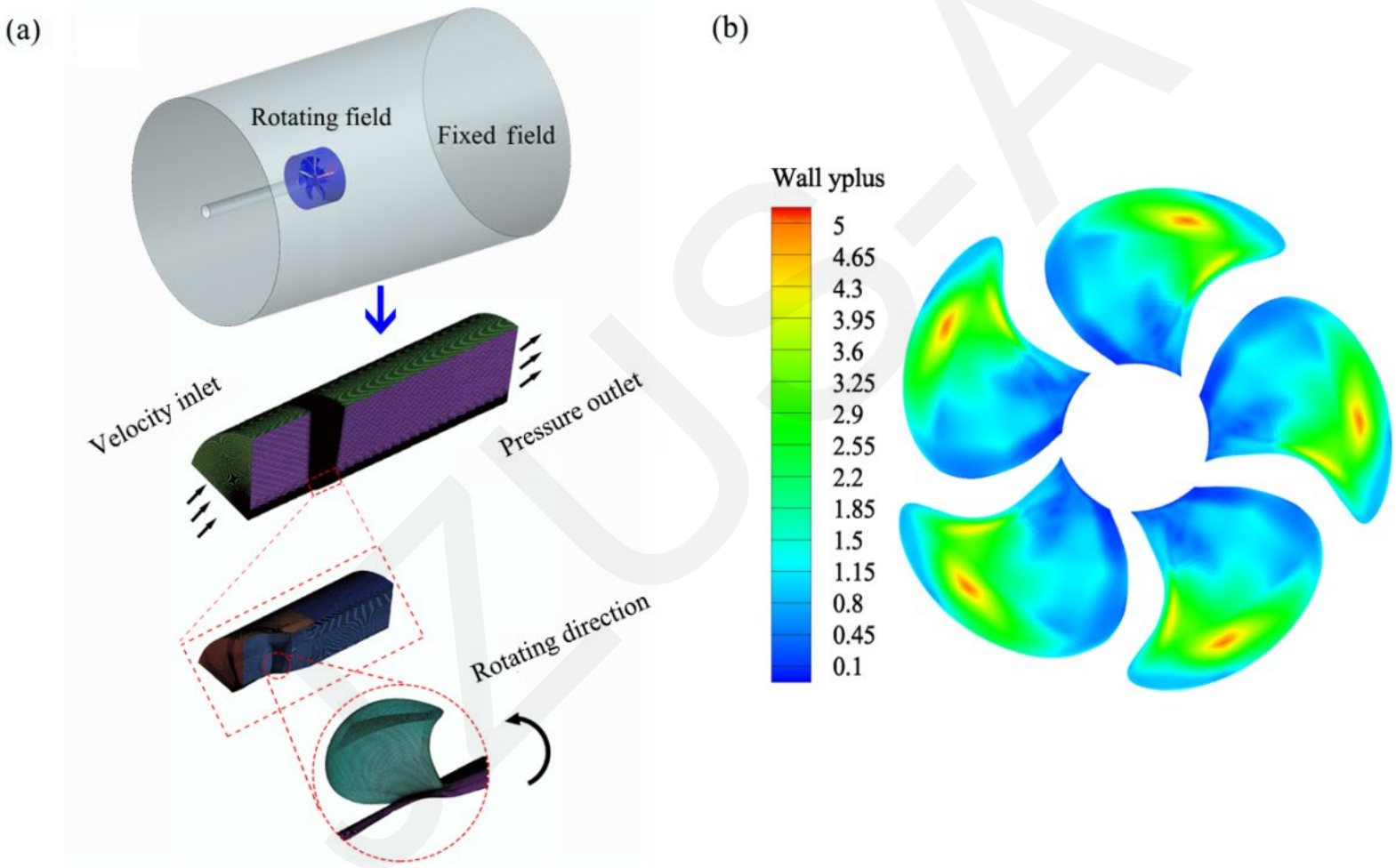


Fig. 1. Calculation domain and grid layout

Turbulence structures

- Coherent structures behind the propeller

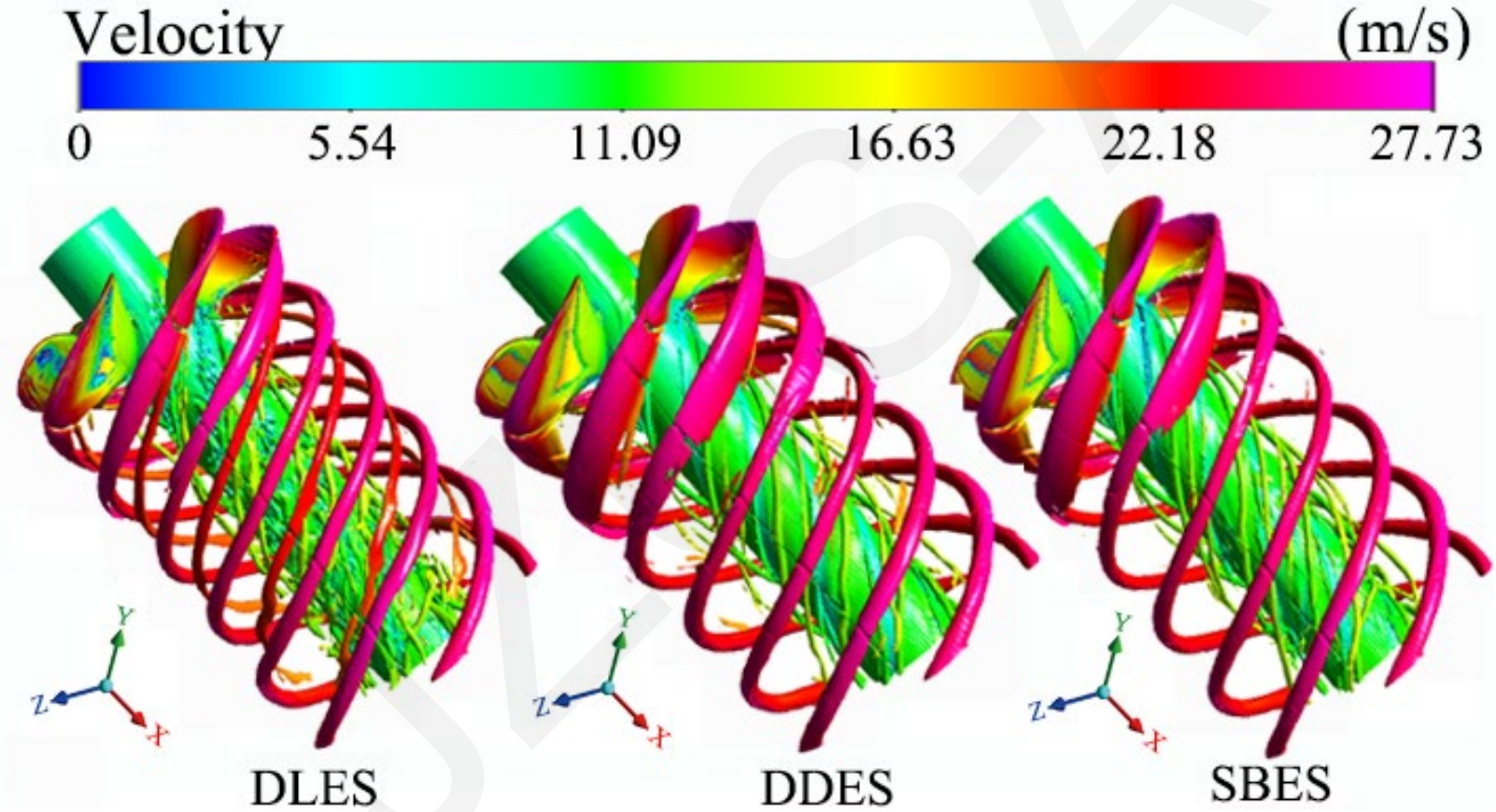


Fig. 2. Vortex distribution behind the propeller

PIV test of a scaled-down propeller

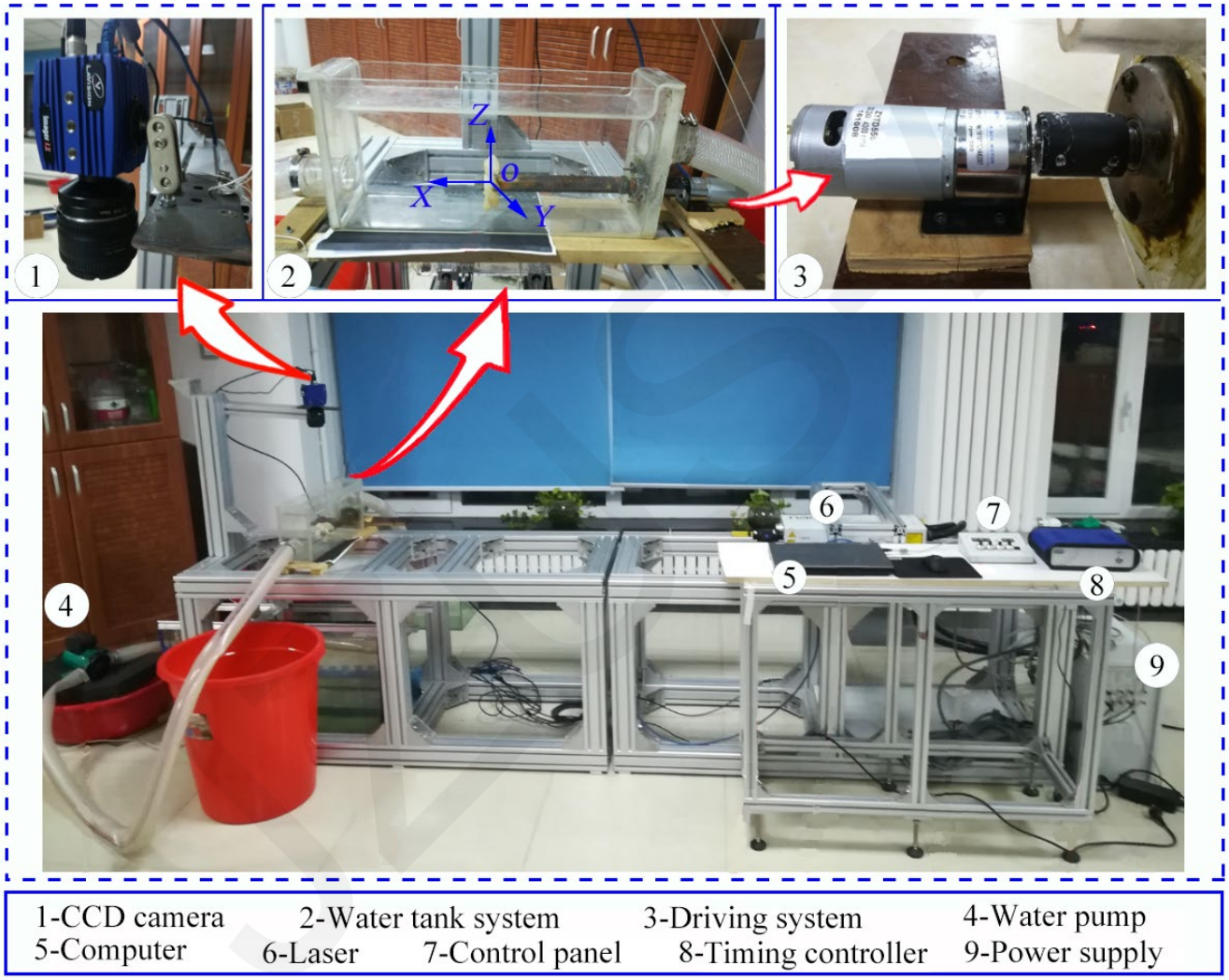


Fig. 3. Basic layout of the PIV system

Comparison of simulation and test

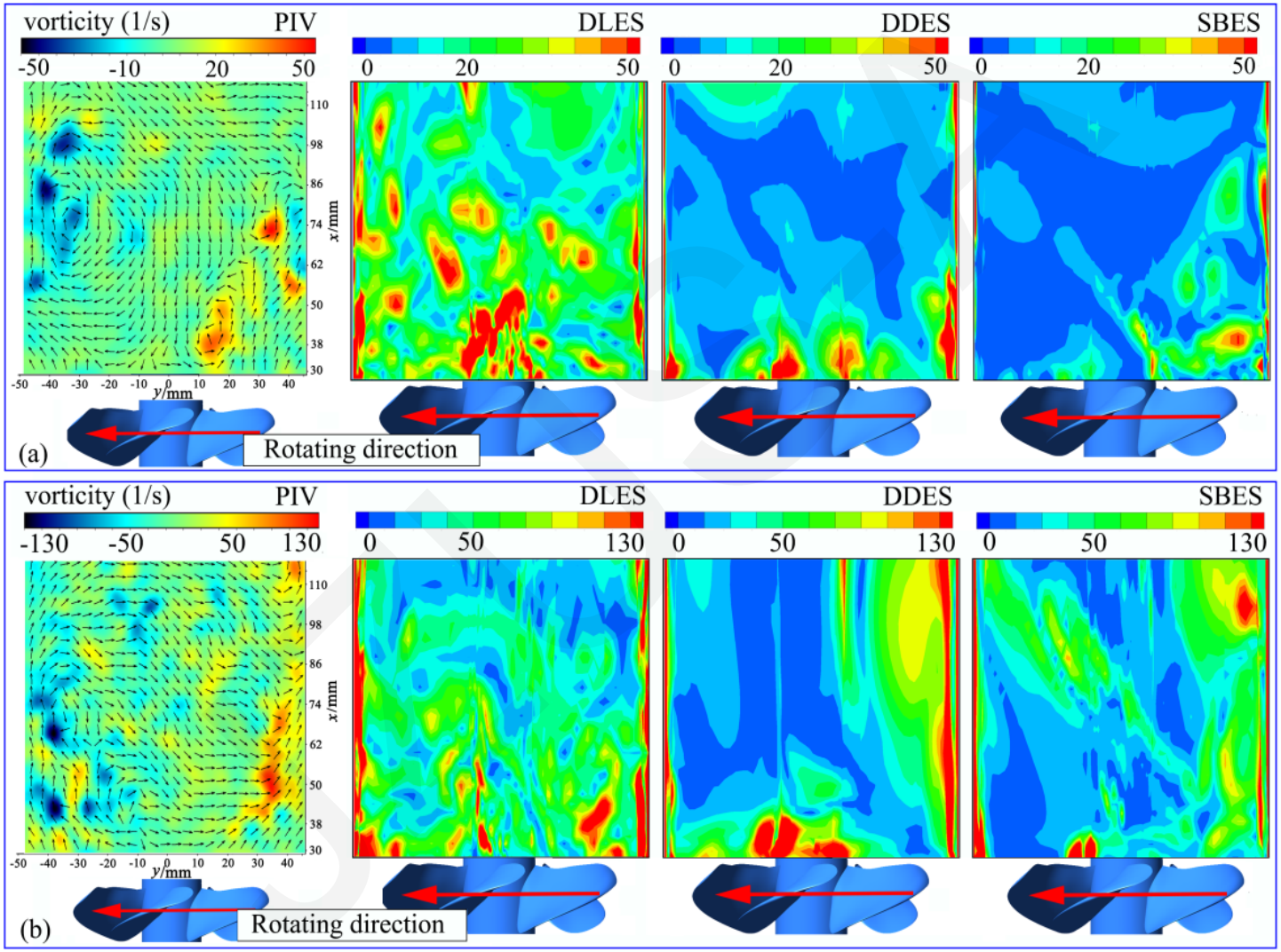


Fig. 4. Instantaneous vorticity field distribution

Comparison of simulation and test

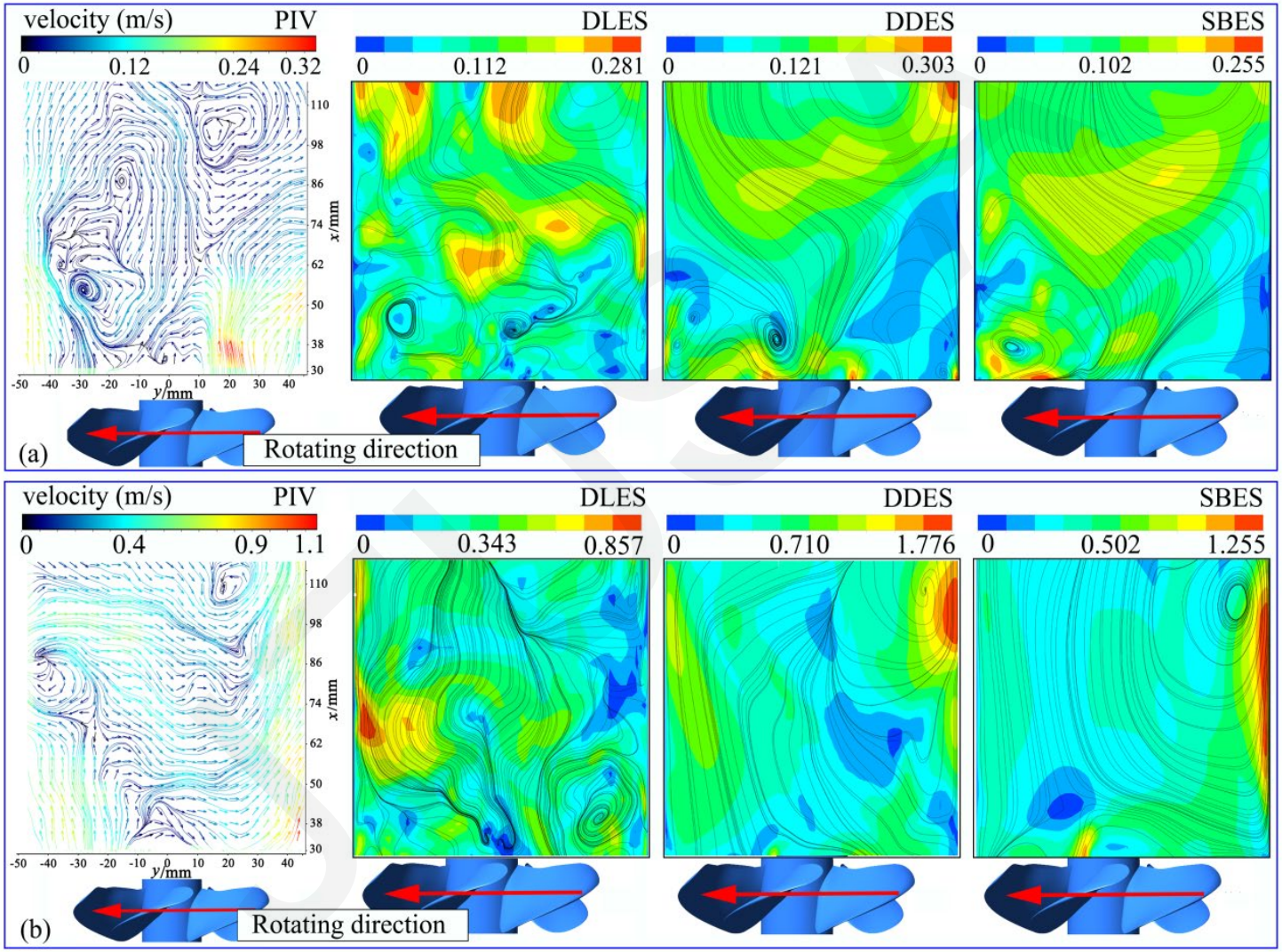


Fig. 5. Instantaneous velocity field distribution

Conclusions

- According to the literature review, the prediction errors of RANS simulation are mainly between 10% and 15%. By SRS approaches, the maximum errors are reduced below 10%. It is found that a remarkable improvement in external performance is achieved.
- The improvement of performance prediction is based on the capture of the flow field. For certain transient unsteady flow simulations, SRS models can give additional flow information compared to RANS models.

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