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TOWARDS EFFICIENT PREDICTION OF NEAR-WALL TRANSITION IN SCALE-RESOLVING SIMULATIONS

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Airfoils in low Reynolds number conditions tend to produce flow separation of the laminar boundary layer already at low angles of attack. Followed by transition of the separated shear layer and consequently by re-attachment, this effect does not imply a full loss of glide efficiency and can be tolerated to a certain extent. However, accurate prediction of the re-attachment then is essential and therefore requires particular attention in the simulation setup.
Typically, RANS models which are capable of transition prediction also capture this process but may not provide sufficient accuracy. It is necessary to resolve the turbulence at least partially. Dealing with low Reynolds numbers, LES and even DNS become feasible for quasi two-dimensional model cases but not for a full wing configuration. The present study compares different model approaches and strategies with respect to accuracy and with respect to the required computational effort. Results will be presented for the flow around a NACA0018 airfoil at a Reynolds number of 80000 based on the setup in Reference [1].
For this configuration hybrid models of DES type which feature zones of LES hardly provide an improvement in terms of computational effort since the required mesh resolution is similar to pure LES. Hence, the presented results also comprise those from an approach based on the SAS model which allows for coarser mesh resolutions than LES yet still partially resolving turbulent scales. Inspired by [2], the SAS model is supplemented with a transition model which produces resolved fluctuations from synthetic turbulence during transition in order to activate the Q_{SAS} term and receive resolved turbulent structures.

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