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CFD-ready Turbulence Models from Gene Expression Programming: Concepts[1] YAOMIN ZHAO, HARSHAL D. AKOLEKAR, RICHARD D. SANDBERG, The University of Melbourne, TURBULENCE SIMULATION MODELLING GROUP TEAM — The gene expression programming (GEP) method is applied to develop Reynolds-averaged Navier-Stokes (RANS) models via symbolic regression. The candidate models, represented by strings of genes competing and evolving in the training, can be interpreted as explicitly given equations. Thus, the resulting model, which minimizes the cost function, can be directly implemented into RANS solvers. Based on the advantages of the GEP method, two training strategies have been proposed to develop CFD-ready RANS models. In the first framework called frozen-training, the models are trained to fit high-fidelity Reynolds stress-data. In the second approach, called CFD-driven training, the fitness of candidate models is evaluated by running RANS calculations in an integrated way. Both methods have been applied to model development for wake mixing in turbomachines. New models are trained based on a high-pressure turbine case and then tested for three additional cases. Despite of the different configurations and operating conditions, the predicted wake mixing profiles are significantly improved in all *a-posteriori* tests. Furthermore, the differences between the models can be analyzed, and it shows that the enhanced wake prediction is predominantly due to the extra diffusion by the CFD-driven model.

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