Existence results for a one-equation turbulent model with feedback forces field

Hermenegildo Borges de Oliveira

FCT - Universidade do Algarve
CMAFCIO - Universidade de Lisboa, Portugal

Resumo: We consider a one-equation turbulent model of the k-epsilon type whose main application is to describe turbulent flows thorugh porous media, but can also be used to model turbulent flows in a rotating frame, aside from turbulent free flows.

For the sake of motivation, we will explain how the model under study is derived from the classical Navier-Stokes equations and we will present examples of feedback forces field that are used in the applications.

We start by considering the classical Navier-Stokes equations with feedback forces field whose presence in the momentum equation will affect the equation for the turbulent kinetic energy (TKE) with a new term that is known as the production and represents the rate at which TKE is transferred from the mean flow to the turbulence.The problem is considered in the steady state and the governing equations are supplemented with homogeneous Dirichlet boundary conditions.

By assuming suitable growth conditions on the feedback forces field and on the function that describes the rate of dissipation of the TKE, as well as on the production function, we will prove the existence of weak solutions to our problem.

We will also prove the existence of weak solutions by assuming the feedback forces field and the turbulent dissipation are strong nonlinearities ,i.e. when no upper restrictions on the growth of these functions with respect to the mean velocity and to the turbulent kinetic energy, respectively, are required.

This result improves, in particular, the existence theory for the classical turbulent k-epsilon model which corresponds to assume that both the feedback and production functions are absent in our model.

This talk is based on some joint works with A. Paiva from FCT - Universidade do Algarve.