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SEMINÁRIO DE ANÁLISE E EQUAÇÕES DIFERENCIAIS

Dia 23 de Abril (quinta-feira), às 14h15, na Sala B3-01

"On the existence of weak solutions to a stationary RANS model with unbounded eddy viscosities"

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Abstract

In a bounded domain $\Omega \subset \mathbb{R}^n$ ($n = 2$ or $n = 3$) we consider the following Reynolds Averaged Navier-Stokes model for the turbulent motion of a viscous incompressible fluid:

$$(1) \qquad \nabla \cdot \mathbf{u} = 0,$$

$$(2) \qquad (\mathbf{u} \cdot \nabla)\mathbf{u} = \operatorname{div}\Big((\nu + \nu_T(k))D(\mathbf{u})\Big) - \nabla p + \mathbf{f},$$

$$(3) \qquad \mathbf{u} \cdot \nabla k = \operatorname{div}\Big((\kappa + \nu_T(k))\nabla k\Big) + \nu_T(k)D(\mathbf{u}) : D(\mathbf{u}) - g(k)\sqrt{k},$$

where: $\mathbf{u} = (u_1, \ldots, u_n)$ mean velocity, p = mean pressure, k = mean turbulent kinetic energy, $D(\mathbf{u}) = \frac{1}{2}\Big(\nabla \mathbf{u} + (\nabla \mathbf{u})^\top\Big)$ rate of strain, and $\nu = \text{const} > 0$ dynamical viscosity, $\nu_T(k)$ = coefficient of eddy viscosity, $\mathbf{f}$ = external force, $\kappa = \text{const} > 0$. The term $g(k)\sqrt{k}$ represents a generalization of the energy dissipation at small length scales.

The growth conditions on $\nu_T(k)$ we are going to consider, include the classical model $\nu_T(k) = C_0\sqrt{k}$ ($C_0 = \text{const} > 0$) [Kolmogorov 1942, Prandtl 1945].

We complete (1)-(3) by the following boundary conditions:

$$(4) \qquad \mathbf{u} = 0, \quad k = k_0 \quad \text{on } \partial\Omega \quad (k_0 \geq 0 \text{ on } \partial\Omega).$$

We prove the existence of weak solutions to (1)-(4) and regularity results for $\mathbf{u}$ and k.

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