Solvability of one mathematical model with Jaumann derivative

Andrey Zvyagin zvyagin@math.vsu.ru
Voronezh State University, Russia

Abstract

It will be consider the solvability in a weak sense of the initial-boundary value problem which describes the motion of low concentrated aqueous polymer solutions:

$$\frac{\partial v}{\partial t} - \nu \Delta v + \sum_{i=1}^{n} v_i \frac{\partial v}{\partial x_i} - \varkappa \frac{\partial \Delta v}{\partial t} - 2\varkappa \text{Div} \left(v_k \frac{\partial \mathcal{E}(v)}{\partial x_k} \right) -$$

$$-2\varkappa \text{Div} \left(\mathcal{E}(v) W(v) - W(v) \mathcal{E}(v) \right) + \text{grad} p = f, \quad (t,x) \in (0,T) \times \Omega;$$

$$\text{div} v = 0, \quad (t,x) \in (0,T) \times \Omega;$$

$$v(x,0) = a_*(x), \quad x \in \Omega; \quad v|_{\partial\Omega \times [0,T]} = 0,$$

where v is the function of velocities at points of the domain Ω in the space $\mathbb{R}^n, n = 2,3$; p is the pressure function; $\mathcal{E}(v)$ is the strain rate tensor; $W(v)$ is the vorticity tensor.

Let denote V - closure $\{v \in C^\infty(\Omega)^n, \text{div} v = 0\}$ in norm of the space $W_2^1(\Omega)^n$.

Theorem. *Let $n = 2, 3$. Then for any $f \in L_2(0,T;V^*)$ the initial-boundary value problem has at least one weak solution.*

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