Международная конференция "Дифференциальные уравнения, теория функций и приложения", 2007, с. 401–401

УДК 517.956

ON PROPAGATION OF PERTURBATIONS FOR SOLUTIONS TO QUASILINEAR PARABOLIC EQUATIONS

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It is well known that perturbations have an infinite velocity of propagation according to the classical heat-conductivity model. However, it was found in [1] that, in the case of a single spatial variable, the above velocity becomes finite under certain natural restrictions for the initial-value function (it suffices to assume that it is positive definite and its derivative is bounded).

Here we present an estimate of the above velocity for a new class of quasilinear parabolic equations. More exactly, the Cauchy problem for the following quasilinear equation is considered (for $\alpha > 0$):

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} + \frac{\alpha}{u}\left(\frac{\partial u}{\partial x}\right)^2 . \tag{1}$$

Assuming that $0 < \sigma \leqslant u_0(x) < \infty$ and $|u_0'(x)| \leqslant M < \infty$, we obtain the estimate

$$\|u\Big|_{t=T}\|_{L(a,b)} \leqslant (b-a)^{\frac{\alpha}{\alpha+1}} \|u_0\|_{L_{\alpha+1}(a-\lambda T, b+\lambda T)}$$

for any positive T and any real a and b such that $a < b$, where λ stands for the constant $\dfrac{(\alpha+1)M(\sup u_0)^\alpha}{\sigma^{\alpha+1}}$.

Nonlinearities of the kind (1) arise, e.g., in models of directed polymers and interface growth (see [2, 3]).

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