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Global-in-time Uniform Convergence for Linear Hyperbolic-Parabolic Singular Perturbations

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摘要   We consider the Cauchy problem ${\varepsilon}{u_{\ep}}''+\delta{u_{\ep}}'+A{u_{\varepsilon}}=0,$ ${u_{\varepsilon}}(0)=u_0, $ ${u_{\varepsilon}}'(0)=u_{1},$ where ${\varepsilon}>0$, $\delta>0$, H is a Hilbert space, and A is a self-adjoint linear non-negative operator on H with dense domain $D(A)$. We study the convergence of $\{{u_{\varepsilon}}\}$ to the solution of the limit problem $\delta u'+A u=0,$ $u(0)=u_0.$ For initial data $(u_{0},u_{1})\in\dau\times H$, we prove global-in-time convergence with respect to strong topologies. Moreover, we estimate the convergence rate in the case where $(u_{0},u_{1})\in D(A^{3/2})\times\dau$, and we show that this regularity requirement is sharp for our estimates. We give also an upper bound for $|{u_{\varepsilon}}'(t)|$ which does not depend on ${\varepsilon}$.

关键词   Parabolic equations   Damped hyperbolic equations   Singular perturbations

分类号   35B25

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Abstract We consider the Cauchy problem ${\varepsilon}{u_{\ep}}''+\delta{u_{\ep}}'+A{u_{\varepsilon}}=0,$ ${u_{\varepsilon}}(0)=u_0, $ ${u_{\varepsilon}}'(0)=u_{1},$ where ${\varepsilon}>0$, $\delta>0$, H is a Hilbert space, and A is a self-adjoint linear non-negative operator on H with dense domain $D(A)$. We study the convergence of $\{{u_{\varepsilon}}\}$ to the solution of the limit problem $\delta u'+A u=0,$ $u(0)=u_0.$ For initial data $(u_{0},u_{1})\in\dau\times H$, we prove global-in-time convergence with respect to strong topologies. Moreover, we estimate the convergence rate in the case where $(u_{0},u_{1})\in D(A^{3/2})\times\dau$, and we show that this regularity requirement is sharp for our estimates. We give also an upper bound for $|{u_{\varepsilon}}'(t)|$ which does not depend on ${\varepsilon}$.

Key words   Parabolic equations   Damped hyperbolic equations   Singular perturbations

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