Khalil, H. K.

Stability analysis of singularly perturbed systems. (English) Zbl 0626.34052

Singular perturbations and asymptotic analysis in control systems, Lect. Notes Control Inf. Sci. 90, 357-373 (1987).

[For the entire collection see Zbl 0605.00020.]

In the first section, the author investigates the singularly perturbed system

$$(1)\quad \dot{x}=f(t,x,z,\epsilon),\quad \epsilon\dot{z}=g(t,x,z,\epsilon),$$

whre $x\in\mathbb{R}^n$, $z\in\mathbb{R}^m$ and $\epsilon>0$ is a small parameter. Theorem 1 states essentially that if the reduced system and the boundary layer system are uniformly asymptotically stable and if interconnection conditions are satisfied, then the origin is a uniformly asymptotically stable equilibrium of (1). An explicit bound on ϵ is given and a Lyapunov function is used from which an estimate of the attraction region could be deduced. These results are particularized to linear time varying systems. In the second section, the author considers a multiparameter singularly perturbed system

$$(2)\quad \dot{x}=f(x,z_1,...,z_N),\quad x\in\mathbb{R}^n,\quad \epsilon_i\dot{z}_i=g_i(x,z_1,...,z_N),\quad z_i\in\mathbb{R}^{m_i},\quad \epsilon_i>0.$$

The stability problem is investigated for all small values of the $\epsilon_i's$. In particular the analysis does not impose bounds on the ratio $\epsilon_i/\epsilon_{i+1}$. As in section 1, assumptions are given for the origin to be an asymptotically stable equilibrium of (2). Bounds on the ϵ_i and a Lyapunov function for system (2) are computed. Although no examples are worked out, the author refers to several applications that can be found in the literature.

Reviewer: P.Habets

MSC:

34D15 Singular perturbations of ordinary differential equations
34D20 Stability of solutions to ordinary differential equations

Keywords:

first order differential equation; singularly perturbed system; small parameter; Lyapunov function