ROCKY MOUNTAIN
JOURNAL OF MATHEMATICS
Volume 34, Number 2, Summer 2004

# THE ADMISSIBLE DISTURBANCE FOR DISCRETE NONLINEAR PERTURBED CONTROLLED SYSTEMS

M. RACHIK, M. LHOUS AND A. TRIDANE

ABSTRACT. Consider the discrete perturbed controlled nonlinear system given by

$$\begin{cases} x^w(i+1) = Ax^w(i) + f(u_i + \alpha_i) \\ \qquad\qquad + g(v_i) \sum_{j=1}^{r} \beta_i^j h_j(x^w(i)) \quad i \geq 0, \\ x^w(0) = x_0 + \gamma \end{cases}$$

and the output function $y^w(i) = Cx^w(i)$, $i \geq 0$, where $w = (\gamma, (\alpha_i)_{i\geq 0}, (\beta_i)_{i\geq 0})$, is a disturbance which disturbs the system. The disturbance $w$ is said to be $\varepsilon$-admissible if $\|y^w(i) - y^{(i)}\| \leq e$, for all $i \geq 0$, where $(y(i))_{i\geq 0}$ is the output signal corresponding to the uninfected controlled system. The set of all $\varepsilon$-admissible disturbances is the admissible set $\mathcal{E}(\varepsilon)$. The characterization of $\mathcal{E}(\varepsilon)$ is investigated and practical algorithms with numerical simulations are given. The admissible set $\overline{\mathcal{E}}(\varepsilon)$ for discrete delayed systems is also considered.

**1. Introduction.** The characterization of admissible sets have important application in the analysis and design of closed-loop systems with state and control constraints. During the control of a system we are always confronted with the presence of certain undesirable parameters that come from the natural relationship which exists between a system and its environment; let's mention as examples fires, transitory electric regimes, earthquakes, bacterial infecting, etc.

In order to face such problems, an important number of works have been developed, see [**1, 2, 4–10, 12**]. We contribute in this direction by exploring a technique which allows us to determine, among a class of disturbances which excite discrete nonlinear controlled systems, those which are $\varepsilon$-admissible.

*Key words and phrases.* Discrete nonlinear systems, disturbances, asymptotic stability, admissibility, observability, discrete delayed systems.
Received by the editors on March 1, 2000, and in revised form on May 21, 2001.