

MAE 286: Hybrid Systems (F10)

Homework #5

Due on 11/3/10

1. (2 points) Consider the sequence of hybrid arcs $\{\phi_i\}_{i=1}^{\infty}$ where $\phi_i : [0, \infty) \times \{0\} \rightarrow \mathbb{R}$, $\phi_i(t, j) = t^i$.
 - Is the sequence locally eventually bounded?
 - Is the graphical limit a hybrid arc?
2. (1 point) Let $\{E_i\}_{i=1}^{\infty}$ be a convergent sequence of hybrid time domains. Prove (carefully and with full details!) that $E = \lim_{i \rightarrow \infty} E_i$ is a hybrid time domain and that $\text{length}(E) = \lim_{i \rightarrow \infty} \text{length}(E_i)$.
3. (2 points) Consider the set-valued map $F : \mathbb{R} \rightrightarrows \mathbb{R}$ given by

$$F(x) = \begin{cases} -1 & x > 0, \\ [-1, 1] & x = 0, \\ 1 & x < 0. \end{cases}$$

Is F outer semicontinuous? Is it locally bounded? Does it take nonempty and convex values? Do solutions exist to the differential inclusion

$$\dot{x} \in F(x) \tag{1}$$

starting from any initial condition? Which ones are they? Are they unique? What is the connection of (1) with $\dot{x} = -\text{sgn}(x)$?