Robustness analysis of control laws for (max,+)-linear systems

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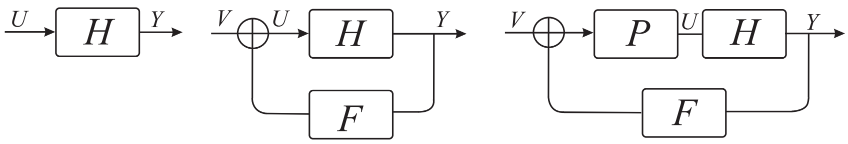
The presentation aim is to analyze the robustness of several controls methods for (max,+)-linear systems. A controller is robust if it guarantees a certain level of performances in spite of the system variations, in regard to its nominal model. The first control method analyzed, was introduced in [1], it is historically the first control method for (max,+)-linear systems. For a given output trajectory $\{y(.)\}$ it consists in finding the greatest input trajectory $\{u(.)\}$ which yields an output trajectory lower than the given one. Next control studied is a closed-loop control introduced in [2], that consists in synthesizing an output feedback controller in a model matching objective, i.e. for a given reference model (represented by its transfer matrix), find the greatest feedback F between output and input, such that the closed-loop system transfer matrix be the same as the open-loop one. The last control method studied is a new approach presented in [3], the control structure is based on the simultaneous utilization of a precompensator and a feedback controller. The various controls structures are illustrated below.



Open-loop structure $Y=HU$ — feedback structure $Y=H(FH)^*V$ — Precompensator and feedback structure $Y=HP(FHP)^*V$

The mains results are based on the residuation theory and the Galois connection (see [4]). Galois connection allows to revisit max-plus residuation theory. Thanks to these results we establish for the open-loop control a transfer function set which ensures that the control performances are preserved in regard to reference output. Next we characterize for a given feedback controller (or a feedback controller with a precompensator), a set of systems such that the input output behavior of a controlled system remains unchanged as long as system transfer belongs to this set.
In the last part the robustness of all these various control will be presented. The main result is that the performances of the new closed-loop structure introduced in [3], is less sensitive to the system variations.

[**1**] F. Baccelli, G. Cohen, G.-J. Olsder and J.-P. Quadrat. *Synchronisation and Linearity : An algebra for Discrete Event Systems.* Wiley and Sons, 1992.

[**2**] B. Cottenceau, L. Hardouin, J.-L. Boimond, and J.-L. Ferrier. *Model reference Control for Timed Event Graphs in Dioid.* Automatica, 37:1451-1458, August 2001.

[**3**] C.-A. Maia, L. Hardouin and R. Santos-Mendes. *Optimal Closed-loop Control of Timed Event Graphs in Dioid.* In International Workshop on Max-algebra (IWMA), Birmingham, UK, 2003. Submited.

[**4**] M. Akian, S. Gaubert and V. Kolokolstov. *Invertibility of Functional Galois Connections.* C. R. Acad. Sci. Paris, Srie I, Vol. 335 (2002), p. 1-6, To appear

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