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▶ **To cite this version:**

Vu Tuan Hieu Le, Cristina Stoica, T. Alamo, E.F. Camacho, Didier Dumur. Guaranteed state estimation by zonotopes for systems with interval uncertainties. SWIM 2012, Jun 2012, Oldenburg, Germany. pp.CD-Rom. hal-00708563

HAL Id: hal-00708563

https://centralesupelec.hal.science/hal-00708563

Submitted on 16 Mar 2020

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Guaranteed state estimation by zonotopes for systems with interval uncertainties

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This talk focuses on guaranteed state estimation by zonotopes [1], [2] applied to multivariable linear discrete-time systems in the presence of disturbances, noises and interval uncertainties. Suppose that the perturbations and the noise are unknown but bounded by some zonotopic sets. Under this hypothesis the information about the system states at each sample time is characterized as a zonotope containing all possible system states that are consistent with the considered perturbations and measurement noise.

In [2] a zonotopic outer approximation of the state estimation domain is computed based on the minimization of the P-radius associated to the zonotope. The main idea consists in an outer approximation of the intersection of a zonotope (corresponding to the prediction of the states) with a strip (the measurement from the available sensor). Despite the good approximation, this approach is applied in [2] only to Single-Input Single-Output systems that are not affected by uncertainties. In order to extend this approach to multivariable systems with interval uncertainties, this talk proposes a zonotopic approximation of the intersection between a zonotope (the prediction of the states) and a polytope (the intersection of the measurements from all the sensors). The size of this zonotope is decreased in time by solving an off-line optimization problem. The advantages of this approach are illustrated via a numerical example.

References

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[2] V.T.H. Le, T. Alamo, E.F. Camacho, C. Stoica, and D. Dumur. A new approach for guaranteed state estimation by zonotopes. In *Proc. of the 18th IFAC World Congress*, Milan, Italy, 2011.

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