Existence and uniqueness tests to solve image evaluation problem.

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Abstract. The problem to be considered is the characterization of the set

$$\mathbb{S} = \{\mathbf{p} \in \mathbb{R}^m, \exists \mathbf{x} \in [\mathbf{x}] \subset \mathbb{R}^n, \mathbf{f}(\mathbf{p}, \mathbf{x}) = \mathbf{0}\}.$$

where $\dim(\mathbf{x}) = \dim(\mathbf{f})$. We shall consider the case where $[\mathbf{x}]$ is small but where dim $\mathbf{x}$ is large whereas dim $\mathbf{p}$ is small. As a consequence, we want to avoid any bissection over the $\mathbf{x}$-space. The set $\mathbb{R}^m$ will be partionned into four zones. The first zone contains points that are outside $\mathbb{S}$. The second zone contains $\mathbf{p} \in \mathbb{S}$ such that there exists a unique $\mathbf{x}$ that satisfies the equations. The third zone constains $\mathbf{p} \in \mathbb{S}$ such that the unicity of the corresponding $\mathbf{x}$ is not proved. The last zone contains $\mathbf{p}$ for which nothing has been proved.

Exemples from [MB79], [JKDW01], [GJ06] are presented in order to show the efficiency of the approach.

References

[GJ06] A. Goldsztejn and L. Jaulin. Inner and outer approximations of existentially quantified equality constraints. In *Proceedings of the Twelfth International Conference on Principles and Practice of Constraint Programming, (CP 2006)*, Nantes (France), 2006.

[JKDW01] L. Jaulin, M. Kieffer, O. Didrit, and E. Walter. *Applied Interval Analysis.* Springer, 2001.

[MB79] Ramon E. Moore and Fritz Bierbaum. *Methods and Applications of Interval Analysis (SIAM Studies in Applied and Numerical Mathematics) (Siam Studies in Applied Mathematics, 2.).* Soc for Industrial & Applied Math, 1979.