HAL
open science

Comments on "Chattering-free digital sliding-mode control with state observer anddisturbance rejection"

Vincent Acary, Bernard Brogliato, Yuri Orlov

To cite this version:

Vincent Acary, Bernard Brogliato, Yuri Orlov. Comments on "Chattering-free digital sliding-mode control with state observer anddisturbance rejection". IEEE Transactions on Automatic Control, 2016, 61 (11), pp.3707. 10.1109/TAC.2015.2509445 . hal-01243532

HAL Id: hal-01243532

https://inria.hal.science/hal-01243532

Submitted on 27 May 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Comments on "Chattering-free digital sliding-mode control with state observer and disturbance rejection"

Vincent Acary[†], Bernard Brogliato[‡♡], Yury V. Orlov[♠]

***Abstract*—An unfortunate mistake in the proof of Proposition 1 in [1] is corrected.**

In the proof of Proposition 1 in [1], the third and fourth items in the followingt list:

- If $x_k > ah$ then $\tilde{x}_{k+1} = x_k - ah$ and $\text{sgn}(\tilde{x}_{k+1}) = 1$,
- If $x_k < -ah$ then $\tilde{x}_{k+1} = x_k + ah$ and $\text{sgn}(\tilde{x}_{k+1}) = -1$,
- If $0 > x_k > -ah$ then $\tilde{x}_{k+1} \in (-ah, 0)$, and $\text{sgn}(\tilde{x}_{k+1}) = -1$,
- If $0 < x_k < ah$ then $\tilde{x}_{k+1} \in (0, ah)$, and $\text{sgn}(\tilde{x}_{k+1}) = 1$.

have to be replaced by the unique item:

- If $x_k \in [-ah, ah]$, then $\tilde{x}_{k+1} = 0$.

which readily follows from the fact that $\tau_{k+1} = \text{proj}([-1, 1]; \frac{x_k}{ah})$, and inserting this into the first line of Equation (4) in [1]: $\tilde{x}_{k+1} = x_k - ah\ \tau_{k+1}$. This is in turn equivalent to the first two lines of Equation (4) in [1], which form a so-called *generalized equation* (since $\text{sgn}(0) = [-1, 1]$) with unknown $\tilde{x}_{k+1}$. It is illustrated on Figure 1, where dashed lines represent the function $\tilde{x}_{k+1} \mapsto \tilde{x}_{k+1} - x_k$, and the solid piecewise-linear curve is the graph of the set-valued map $\tilde{x}_{k+1} \mapsto -ah\ \text{sgn}(\tilde{x}_{k+1})$. Case 1: $x_k < -ah$, case 2: $x_k = -ah$, case 3: $x_k \in (-ah, ah)$, case 4: $x_k = ah$, case 5: $x_k > ah$. Once $\tilde{x}_{k+1}$ and τ_{k+1} are known, the third line of Equation (4) in [1] can be used to advance the algorithm to step $k + 1$.

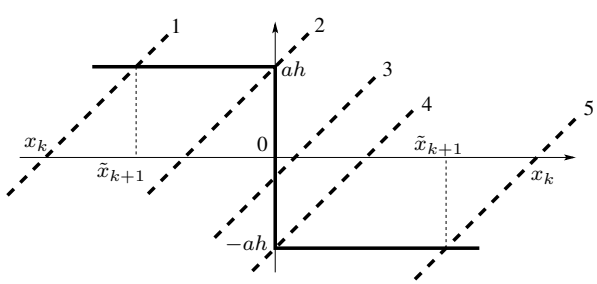

Fig. 1. The variable $\tilde{x}_{k+1}$ as a solution of the generalized equation $\tilde{x}_{k+1} - x_k \in ah\ \text{sgn}(\tilde{x}_{k+1})$.

[†] INRIA Grenoble Rhône-Alpes, BIPOP project-team, 655 avenue de l'Europe, Inovallée, 38334 Saint-Ismier, France; vincent.acary@inrialpes.fr

[‡]INRIA Grenoble Rhône-Alpes, BIPOP project-team, 655 avenue de l'Europe, Inovallée, 38334 Saint-Ismier, France; bernard.brogliato@inrialpes.fr

[♡] Corresponding author.

[♠]CICESE, Departamento de Electronica y Telecomunicaciones, Km.107, Carretera Tijuana-Ensenada, 22860 Mexico; yorlov@cicese.mx

References

[1] V. Acary, B. Brogliato, Y. Orlov, "Chattering-free digital sliding-mode control with state observer and disturbance rejection", IEEE Transasctions on Automatic Control, vol.57, no 5, pp.1087-1101, May 2012.