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# Comments on “Chattering-free digital sliding-mode control with state observer and disturbance rejection”

Vincent Acary<sup>†</sup>, Bernard Brogliato<sup>‡</sup>, Yury V. Orlov<sup>♣</sup>

**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 following 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  $\tau_{k+1}$  are known, the third line of Equation (4) in [1] can be used to advance the algorithm to step  $k + 1$ .

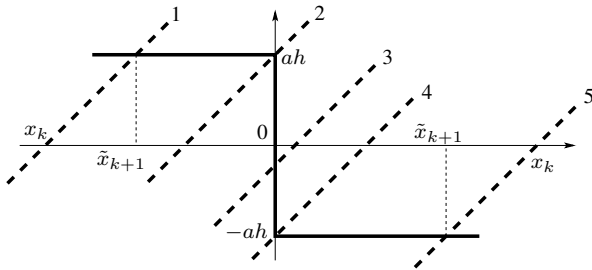


Fig. 1. The variable  $\tilde{x}_{k+1}$  as a solution of the generalized equation  $\tilde{x}_{k+1} - x_k \in ah \text{sgn}(\tilde{x}_{k+1})$ .

## REFERENCES

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

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