Scientists clear the chatter of buck converters

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Buck converters, also known as step down converters, are chatty Cathys. The systems produce less power than they receive, and the tracking signals in the output can get stuck—the result is a small but harmful frequency fluctuation.

A research team composed of scientists from Golestan University, Concordia University, and Delft University of Technology has proposed a way to cut the chatter. The researchers published their study in *IEEE/CAA Journal of Automatica Sinica* (*JAS*), a joint publication of the IEEE and the Chinese Association of Automation.

The chatter can lead to worn hardware, dangerous temperature changes in the circuits, and it makes the system difficult to control accurately. "In order to suppress the chattering, a high order sliding mode control technique was [previously] proposed, and has been established as the most successful chattering avoidance method," wrote Prof. Hassan HosseinNia, Delft University of Technology in the Netherlands.

The problem, he continued, is that the control method becomes less reliable and robust if unknown variables come into play. Hossein Nia and his team built upon the previously proposed sliding mode control technique in which the systems are nonlinear and time-dependent, so the control is discontinuous. The technique basically samples the system, creating a representative sample of the system's typical behavior. To eliminate the chatter and better control the system, the scientists designed what they call a second-order sliding mode controller via twisting algorithm.

"...the purpose of the sliding mode control for [the] buck converter is to control the output voltage," HosseinNia wrote. Since the output is known, the researchers need to control the other variables to meet the desired output. "The adaptive sliding mode control method for controlling the buck converter voltage leads to a more effective performance against disturbances and system uncertainties to the [sliding mode control] method; the only difference is that in this method, the parameter in [the] sliding line is not constant."

By allowing flexibility in the sliding line parameter, the researchers can clear the chatter while retaining robustness of the system at the output. "Experimental validation of the present design proves that the control and tracking performance is improved in the presence of uncertainties and disturbances while the stability is maintained," HosseinNia wrote. The scientists built a prototype buck converter to test the designs, and found that their method provided the most efficient performance with the best settling time of the output voltage—eliminating the chatter.

More information: Seyed Mehdi RakhtAla et al, Design of second order sliding mode and sliding mode algorithms: a practical insight to DC-DC buck converter, *IEEE/CAA Journal of Automatica Sinica* (2017). DOI: 10.1109/JAS.2017.7510550

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