

Accepted Manuscript

Stability Analysis of Nonlinear Digital Systems under Hardware Overflow Constraint for Dealing with Finite Word-Length Effects of Digital Technologies

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PII: S0165-1684(17)30165-2
DOI: [10.1016/j.sigpro.2017.05.004](https://doi.org/10.1016/j.sigpro.2017.05.004)
Reference: SIGPRO 6471



To appear in: *Signal Processing*

Received date: 14 December 2016
Revised date: 1 May 2017
Accepted date: 3 May 2017

Please cite this article as: Muhammad Umair Amjad, Muhammad Rehan, Muhammad Tufail, Choon Ki Ahn, Haroon Ur Rashid, Stability Analysis of Nonlinear Digital Systems under Hardware Overflow Constraint for Dealing with Finite Word-Length Effects of Digital Technologies, *Signal Processing* (2017), doi: [10.1016/j.sigpro.2017.05.004](https://doi.org/10.1016/j.sigpro.2017.05.004)

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Highlights

- In contrast to the previous works on the stability analysis of the digital systems (or filters) under overflow constraint, the effects of both the overflow nonlinearity and the nonlinear dynamical digital component have been studied while acquiring the stability conditions for the nonlinear digital systems for consideration of hardware implementation.
- The present work addresses a fundamental and inaugural problem of the stability analysis of the digital systems with hardware constraints and inherent nonlinear complexity. Therefore, the proposed approach can handle the nonlinear filtering algorithms and can also be readily applied to the linear counterpart as a specific case.
- In addition, the resultant analysis conditions can be applied to the nonlinear digital systems under overflow nonlinearity in the presence of bounded external interferences to attain an idea of the external interferences attenuation level of a filter.
- The stability criteria have been applied to the overflow oscillation elimination analysis of two nonlinear physical systems, including state filter for the observer of Moon chaotic system and recurrent neural network (RNN) and the solutions attained are provided to depict validity of the proposed approaches.

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