A Family of Quaternion-valued Pipelined Second-order Volterra Adaptive Filters for Nonlinear System Identification

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Research Article

Keywords: online quaternion system, Pipelined structure, Quaternion-valued SOV, Widely nonlinear, Strictly nonlinear, Semi-widely nonlinear

Posted Date: June 28th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-611008/v1>

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Version of Record: A version of this preprint was published at Nonlinear Dynamics on April 18th, 2022.
See the published version at <https://doi.org/10.1007/s11071-022-07425-3>.

Abstract

This paper primarily proposes a family of quaternion Volterra filters based on the feedforward pipelined structure (QPSOAVFs) for nonlinear quaternion system identification to reduce the computational complexity. Then, the strictly nonlinear QPSOAVF (SNL-QPSOAVF), semi-widely nonlinear QPSOAVF (SWNL-QPSOAVF), and widely nonlinear QPSOAVF (WNL-QPSOAVF), are proposed. This architecture consists of several quaternion-valued second-order Volterra (SOV) modules. The structure's nonlinear subsection executes a nonlinear mapping from the input space to an intermediate space using the feedforward SOV; the linear combiner subsection performs a linear mapping from the intermediate space to the output space. Moreover, the theoretical analysis expresses the effectiveness of the proposed QPSOAVFs in a specific condition. Finally, simulation results further prove that the proposed QPSOAVFs have good performance in identifying the quaternion-valued nonlinear system.

Full Text

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