Delay-Dependent Stability Analysis for Large Scale Production Networks of Autonomous Work Systems

H.R. Karimi\(^1\)*, S. Dashkovskiy\(^2\) and N.A. Duffie\(^3\)

\(^1\) Faculty of Technology and Science, University of Agder, Grimstad, Norway
\(^2\) Centre for Industrial Mathematics, University of Bremen, Bremen, Germany
\(^3\) Department of Mechanical Engineering, University of Wisconsin-Madison, Madison, USA

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Abstract: This paper considers the problem of stability analysis for a class of production networks of autonomous work systems with delays in the capacity changes. The system under consideration does not share information between work systems and the work systems adjust capacity with the objective of maintaining a desired amount of local work in progress (WIP). Attention is focused to derive explicit sufficient delay-dependent stability conditions for the network using properties of matrix norm. Finally, numerical results are provided to demonstrate the proposed approach.

Keywords: stability analysis; production networks; autonomous systems; delay.

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1 Introduction

Production networks are emerging as a new type of cooperation between and within companies, requiring new techniques and methods for their operation and management [1]. Coordination of resource use is a key challenge in achieving short delivery times and delivery time reliability. These networks can exhibit unfavourable dynamic behaviour as individual organizations respond to variations in orders in the absence of sufficient communication and collaboration, leading to recommendations that supply chains should be globally rather than locally controlled and that information sharing should be extensive [2, 3]. However, the dynamic and structural complexity of these emerging networks inhibits collection of the information necessary for centralized planning and control, and

* Corresponding author: hamid.r.karimi@uia.no