

Efficient real-time remote data propagation mechanism for a Component-Based approach to distributed manufacturing

V. Barot*, S. McLeod, R. Harrison, and A. A. West

Abstract— Manufacturing Industries face a crucial change as products and processes are required to, easily and efficiently, be reconfigurable and reusable. In order to stay competitive and flexible, situations also demand distribution of enterprises globally, which requires implementation of efficient communication strategies. A prototype system called the "Broadcaster" has been developed with an assumption that the control environment description has been engineered using the Component-based system paradigm. This prototype distributes information to a number of globally distributed partners via an adoption of the circular-based data processing mechanism. The work highlighted in this paper includes the implementation of this mechanism in the domain of the manufacturing industry.

The proposed solution enables real-time remote propagation of machine information to a number of distributed supply chain client resources such as a HMI, VRML-based 3D views and remote client instances regardless of their distribution nature and/or their mechanisms. This approach is presented together with a set of evaluation results. Authors' main concentration surrounds the reliability and the performance metric of the adopted approach. Performance evaluation is carried out in terms of the response times taken to process the data in this domain and compared with an alternative data processing implementation such as the linear queue mechanism. Based on the evaluation results obtained, authors justify the benefits achieved from this proposed implementation and highlight any further research work that is to be carried out.

Keywords— Broadcaster, circular buffer, Component-based, distributed manufacturing, remote data propagation.

I. INTRODUCTION

GLOBALISATION has led the manufacturing industries to face a crucial change from a vendor's to a customer market. Since it is a customer who controls the global market, change in their demands and expectations results into a dramatic fluctuation to the entire production process. In order to stay competitive by satisfying customer demands and expectations, industries must shorten their product life cycles, reduce the time to market their products, add variations to their products, satisfy customer demands quickly and reduce their investment costs. Furthermore, these consequences imply more

complex products, faster changing products and faster introduction of products [1].

Modern manufacturing production systems have to respond quickly to these continuous changes to meet the demands faced in this emerging agile manufacturing environment [2]. This requires systems to easily be reconfigurable to accommodate changes in the production process [3], [4], and geographically distribute manufacturing activities in order to stay competitive and flexible [5]. A good communication strategy has to be adopted to satisfy the requirements identified by this distribution of manufacturing activities. Manufacturing information must be delivered efficiently in soft real-time basis to a number of global supply chain engineering partners regardless of their distribution nature and / or their mechanisms. In order to achieve this, a prototype system has been developed at Loughborough University. This prototype is called "Broadcaster", which has been designed as a data propagation tool. Its aim is to efficiently deliver real-time manufacturing information to a number of remote distributed partners regardless of their geographic locations or implementation mechanisms.

The main aim of this paper is to highlight the implementation of an efficient data propagation mechanism presented for the "Broadcaster" prototype. This is to distribute information from the manufacturing sources to the remote manufacturing destinations, reliably without compromising the performance metric. The description of this approach is presented together with some evaluation results which are obtained from this implementation. The work concentrates particularly on the reliability and performance of this adopted mechanism. This paper is organised as follows. The next section describes the Component-Based automation approach followed by the section three which details the data propagation mechanism together with the algorithm which has been implemented. Section four shows the overall test bed set up used to obtain the evaluation results. Conclusions are drawn in the section five of this paper, and based on the results obtained, benefits and further work is justified.

II. COMPONENT-BASED FOUNDATION

Component-Based (CB) approach not only meets the manufacturing requirements identified in the section one of this paper, but it also addresses the reconfiguration and reuse problems faced by the manufacturing industry [4]. CB paradigm aims to replace the existing widely used PLC based

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Nature Inspired Computing for Data Science Minakhi Rout, Jitendra Kumar Rout, Himansu Das, 2019-11-26 This book discusses the current research and concepts in data science and how these can be addressed using different nature inspired optimization techniques Focusing on various data science problems including classification clustering forecasting and deep learning it explores how researchers are using nature inspired optimization techniques to find solutions to these problems in domains such as disease analysis and health care object recognition vehicular ad hoc networking high dimensional data analysis gene expression analysis microgrids and deep learning As such it provides insights and inspiration for researchers to wanting to employ nature inspired optimization techniques in their own endeavors

Renewable Energy from Small & Micro Hydro Projects Shambhu Ratan Awasthi, Shiv Vishal Pandey, 2021-03-24 Energy production and utilization are directly associated with climate change Harnessing energy from renewables can provide a viable path towards achieving sustainability and reducing carbon footprints which can help mitigate the harmful effects of climate change India is endowed with substantial hydropower potential Under this light Renewable Energy from Small Micro Hydro Projects practical aspects case studies introduces the process of developing hydropower projects especially in Indian context The role of hydroelectric power as part of water management in combating climate change also forms the subject matter of this book Selection of suitable sites hydro turbines electrical systems transportation and salient features of dam and reservoir operation are discussed Cost estimation feasibility studies promotional policies of the government and other organizations involved in hydropower also form the subject matter of the title The publication also covers the basics of fluid mechanics along with an overview of the hydropower development in India and the world The book is supplemented with statistical data relevant to development and operation of hydropower projects which makes the text an authentic read It will be a useful guide and reference to students designers planners consultants and field engineers engaged in hydro energy sector

Canadian Journal of Civil Engineering, 2001

ASCE Combined Index American Society of Civil Engineers, 1986 Indexes materials appearing in the Society's Journals Transactions Manuals and reports Special publications and Civil engineering

Flow-Based Optimization of Products or Devices Nils Tångefjord Basse, 2020-11-13 Flow based optimization of products and devices is an immature field compared to the corresponding topology optimization based on solid mechanics However it is an essential part of component development with both internal and or external flow The aim of this book is two fold i to provide state of the art examples of flow based optimization and ii to present a review of topology optimization for fluid based problems

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flow path the optimum design needs to be recreated in a CAD model A method has been developed which eliminates the need to recreate the optimal results in CAD This is accomplished by using mesh morphing CAD and CFD together in an optimization framework The method developed has been implemented with a significant time savings over the use of a traditional meshing optimization framework **Automated Flow Path Design Optimization Using Mesh Morphing**

William D. Gough,2011 The use of CAD models and CFD analysis has become an essential part of fluid flow design To reduce the time spent determining a design optimization frameworks have been implemented to automate the process Mesh morphing has been implemented within these frameworks to further reduce the time needed While optimization methods have been developed to optimize a fluid flow path the optimum design needs to be recreated in a CAD model A method has been developed which eliminates the need to recreate the optimal results in CAD This is accomplished by using mesh morphing CAD and CFD together in an optimization framework The method developed has been implemented with a significant time savings over the use of a traditional meshing optimization framework **Methods for Design**

Optimization Using High Fidelity Turbulent Flow Simulations Chaitanya Anil Talnikar,2015 Design optimization with high fidelity turbulent flow simulations can be challenging due to noisy and expensive objective function evaluations The noise decays slowly as computation cost increases therefore is significant in most simulations It is often unpredictable due to chaotic dynamics of turbulence in that it can be totally different for almost identical simulations This thesis presents a modified parallel Bayesian optimization algorithm designed for performing optimization with high fidelity simulations It strives to find the optimum in a minimum number of evaluations by judiciously exploring the design space Additionally to potentially augment the optimization algorithm with the availability of a gradient a massively parallel discrete unsteady adjoint solver for the compressible Navier Stokes equations is derived and implemented Both the methods are demonstrated on a large scale transonic fluid flow problem in a turbomachinery component **A Continuous Adjoint Approach to**

Design Optimization in Multiphase Flow David A. Boger,2013 Perspectives in Flow Control and Optimization Max D. Gunzburger,2003-01-01 Flow control and optimization has been an important part of experimental flow science throughout the last century As research in computational fluid dynamics CFD matured CFD codes were routinely used for the simulation of fluid flows Subsequently mathematicians and engineers began examining the use of CFD algorithms and codes for optimization and control problems for fluid flows Perspectives in Flow Control and Optimization presents flow control and optimization as a subdiscipline of computational mathematics and computational engineering It introduces the development and analysis of several approaches for solving flow control and optimization problems through the use of modern CFD and optimization methods The author discusses many of the issues that arise in the practical implementation of algorithms for flow control and optimization and provides the reader with a clear idea of what types of flow control and optimization problems can be solved how to develop effective algorithms for solving such problems and potential problems in

implementing the algorithms Audience this book is written for both those new to the field of control and optimization as well as experienced practitioners including engineers applied mathematicians and scientists interested in computational methods for flow control and optimization Readers with a solid background in calculus and only slight familiarity with partial differential equations should find the book easy to understand Knowledge of fluid mechanics computational fluid dynamics calculus of variations control theory or optimization is beneficial but is not essential to comprehend the bulk of the presentation Only Chapter 6 requires a substantially higher level of mathematical knowledge most notably in the areas of functional analysis numerical analysis and partial differential equations

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