

Cranfield University

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**Feature Based Design**  
**for**  
**Jigless Assembly**

School of Industrial and Manufacturing Science

PhD Thesis

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Academic year 2003-04

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June 2004

This thesis is submitted in partial fulfilment of the requirements  
for the degree of Doctor of Philosophy

# Abstract

The work presented in this thesis was undertaken as part of the three-year ‘Jigless Aerospace Manufacture’ (JAM) project which was set-up to investigate and address the significant scientific, technological and economic issues to enable a new design, manufacture and assembly philosophy based on minimising product specific jigs, fixtures and tooling.

The main goal of the JAM project at Cranfield was the development of appropriate jigless methods and principles, and the subsequent redesign of the JAM project demonstrator structure – a section of the Airbus A320 aircraft Fixed Leading Edge – to fully investigate and realise the capabilities of jigless methodologies and principles.

The particular focus of research activity described in this thesis was the development of a methodology to design for jigless assembly and a process of selecting assembly features to enable jigless assembly.

A review of the literature has shown that no methodologies exist to specifically design for jigless assembly; however, previous relevant research has been built upon and extended with the incorporation of novel tools and techniques.

To facilitate the assembly feature selection process for jigless assembly, an Assembly Feature Library was created that broadened and expanded the conventional definition and use of assembly features.

The developed methodology, assembly feature selection process and Feature Library have been applied and validated on the JAM project demonstrator structure to serve as a Case Study for the tools and techniques developed by the research.

Additionally, a Costing Analysis was carried out which suggests that the use of the tools and techniques to enable jigless assembly could have a large and considerable impact on both the Non-Recurring and Recurring costs associated with the design, manufacture and assembly of aircraft.

# Acknowledgements

I would like to express my deepest gratitude to my supervisor, Professor John Corbett, for his enduring guidance, support and patience throughout all of these past years. I would also like to acknowledge Randolph and Graham, the other members of the JAM team at Cranfield, whose continuing encouragement made the PhD process a little, bit easier.

Many people have helped towards the completion of this research from both academia and industry and I would like to take this opportunity to thank all of those people. In addition, I am also thankful to all of the friends that I have made during my time at Cranfield for making the place more bearable.

I would like to thank my parents, and my sister, for all the support and encouragement they have given me before, during and after the PhD.

And last but by definitely no means least, I would like to say a special thanks to Mariona for being here every step of the way, without whom I would never have finished.

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# List of Publications

Burley, G. J.; Odi, R.; Naing, S.; Williamson, A. and Corbett, J. **Jigless aerospace manufacture – the enabling technologies.** IN: Proceedings of the Society of Automotive Engineers (SAE) Aerospace Manufacturing Technology Conference & Exposition (AMTC), 8-10 June 1999, Bellevue, Washington, USA.

Naing, S.; Burley, G. J.; Odi, R.; Williamson, A. and Corbett, J. **Design for tooling to enable jigless assembly: an overview.** IN: Proceedings of the International Institution for Production Engineering Research (CIRP) Design Seminar on Design with Manufacturing: Intelligent Design Concepts Methods and Algorithms, 16-18 May 2000, Haifa, Israel.

Naing, S.; Burley, G. J.; Odi, R.; Williamson, A. and Corbett, J. **Design for tooling to enable jigless assembly – an integrated methodology for jigless assembly.** IN: Proceedings of the Society of Automotive Engineers (SAE) Aerospace Manufacturing Technology Conference & Exposition (AMTC), 16-18 May 2000, Fort Worth, Texas, USA.

Odi, R.; Burley, G. J.; Naing, S.; Williamson, A. and Corbett, J. **Error budgeting and the design of large aerostructures.** IN: Proceedings of the 22<sup>nd</sup> Congress of the International Council of the Aeronautical Sciences (ICAS), 27 August-1 September 2000, Harrogate, UK.

Burley, G. J.; Naing, S.; Odi, R. and Corbett, J. **Using structurally integrated location and reference features in the assembly of large aerospace structures.** IN: Proceedings of the Society of Automotive Engineers (SAE) Aerospace Automated Fastening Conference & Exposition (Aerofast), 20-22 September 2000, New Orleans, Louisiana, USA.

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Naing, S.; Burley, G. J.; Odi, R. and Corbett, J. **Design for jigless assembly – case study of a civil airliner fixed leading edge.** IN: Proceedings of the American Institute of Aeronautics and Astronautics (AIAA) 42<sup>nd</sup> Structures, Structural Dynamics and Materials Conference and Exhibit, 16-19 April 2001, Seattle, Washington, USA.

Odi, R.; Burley, G. J.; Naing, S. and Corbett, J. **Error budgeting for assembly-centric design of aerostructures.** IN: Proceedings of the American Institute of Aeronautics and Astronautics (AIAA) 42<sup>nd</sup> Structures, Structural Dynamics and Materials Conference and Exhibit, 16-19 April 2001, Seattle, Washington, USA.

Odi, R.; Burley, G. J.; Naing, S. and Corbett, J. **Geometric and dimensional tolerances in error budgeting for assembly-centric design of aerostructures.** IN: Proceedings of the International Institution for Production Engineering Research (CIRP) 7<sup>th</sup> International Seminar on Computer Aided Tolerancing, 24-25 April 2001, Paris, France.

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