Friction Stir Welding With Abaqus

Static Test Simulation of Refill Friction Stir Spot Welded and Riveted Coupons Using Finite Element Analysis

Issues in Technology Theory, Research, and Application: 2013 Edition

Fatigue in Friction Stir Welding

2nd International Conference on Mechanical, Manufacturing and Process Plant Engineering

Integrative Production Technology

Advanced Design and Manufacture to Gain a Competitive Edge

Athermal Process Modeling 2014:

Friction Stir Welding and Processing in Alloy Manufacturing

Friction Stir Welding and Processing Advances in Friction-Stir Welding and Processing

Computational Methods and Production Engineering

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Smoothed Particle Hydrodynamics Simulations for Design and Manufacturing

Trends in Welding Research

Friction Science and Technology

Welding Science and Technology

Proceedings of ICDMC 2019

Improved Performance of Materials

Friction Stir Welding and Processing Proceedings of International Conference on Intelligent Manufacturing and Automation

Mechanics of Materials in Modern Manufacturing


Cold-Spray Coatings

Friction Stir Welding and Processing

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Fracture at All Scales

Residual Stress Analysis on Welded Joints by Means of Numerical Simulation and Experiments

"Should have broad appeal in many kinds of industry, ranging from automotive to computers—basically any organization concerned with products having moving parts!" —David A. Rigney, Materials Science and Engineering Department, Ohio State University, Columbus, USA

In-Depth Coverage of Frictional Concepts

Friction affects so many aspects of daily life that most take it for granted. Arguably, mankind's attempt to control friction dates back to the invention of the wheel. Friction Science and Technology: From Concepts to Applications, Second Edition presents a broad, multidisciplinary overview of the constantly moving field of friction, spanning the history of friction studies to the evolution of measurement instruments. It reviews the gamut of friction test methods, ranging from simple inclined planes to sophisticated laboratory tribometers. The book starts with introductory concepts about friction and progressively delves into the more subtle fundamentals of surface contact, use of various lubricants, and specific applications such as brakes, piston rings, and machine components. Includes American Society of Testing and Management (ASTM) Standards

This volume covers multiple facets of friction, with numerous interesting and unusual examples of friction-related technologies not found in other tribology books. These include: Friction in winter sports Friction of touch and human skin Friction of footwear and biomaterials Friction drilling of metals Friction of tires and road surfaces Describing the tools of the trade for friction research, this edition enables engineers to purchase or build their own devices. It also discusses frictional behavior of a wide range of materials, coatings, and surface treatments, both traditional and advanced, such as thermally oxidized titanium alloys, nanocomposites, ultra-low friction films, laser-dimpled ceramics, and carbon composites. Even after centuries of study, friction continues to
conceal its subtle origins, especially in practical engineering situations in which surfaces are exposed to complex and changing environments. Authored by a field specialist with more than 30 years of experience, this one-stop resource discusses all aspects of friction, from its humble beginnings to its broad application for modern engineers.

The ability to quantify residual stresses induced by welding processes through experimentation or numerical simulation has become, today more than ever, of strategic importance in the context of their application to advanced design. This is an ongoing challenge that commenced many years ago. Recent design criteria endeavour to quantify the effect of residual stresses on fatigue strength of welded joints to allow a more efficient use of materials and a greater reliability of welded structures. The aim of the present book is contributing to these aspects of design through a collection of case-studies that illustrate both standard and advanced experimental and numerical methodologies used to assess the residual stress field in welded joints. The work is intended to be of assistance to designers, industrial engineers and academics who want to deepen their knowledge of this challenging topic.

This book covers the rapidly growing area of friction stir welding. It also addresses the use of the technology for other types of materials processing, including superplastic forming, casting modification, and surface treatments. The book has been prepared to serve as the first general reference on friction stir technology. Information is provided on tools, machines, process modeling, material flow, microstructural development and properties. Materials addressed include aluminum alloys, titanium alloys, steels, nickel-base alloys, and copper alloys. The chapters have been written by the leading experts in this field, representing leading industrial companies and university and government research institutions.

This book gathers selected papers presented at the Second International Conference on Intelligent Manufacturing and Automation (ICIMA 2020), which was jointly organized by the Departments of Mechanical Engineering and Production Engineering at Dwarkadas J. Sanghvi College of Engineering (DJSCE), Mumbai, and by the Indian Society of Manufacturing Engineers (ISME). Covering a range of topics in intelligent manufacturing, automation, advanced materials and design, it focuses on the latest advances in e.g. CAD/CAM/CAE/CIM/FMS in manufacturing, artificial intelligence in manufacturing, IoT in manufacturing, product design & development, DFM/DFA/FMEA, MEMS & nanotechnology, rapid prototyping, computational techniques, nano- & micro-machining, sustainable manufacturing, industrial engineering, manufacturing process management, modelling & optimization techniques, CRM, MRQ & ERP, green, lean & agile manufacturing, logistics & supply chain management, quality assurance & environmental protection, advanced material processing & characterization of composite & smart materials. The book is intended as a reference guide for future researchers, and as a valuable resource for students in graduate and doctoral programmes.

This symposium focuses on all aspects of science and technology related to friction stir welding and processing. This is the eighth proceedings volume from this recurring TMS symposium.

This volume presents selected papers from the 2nd International Conference on Mechanical, Manufacturing and Process Plant Engineering (ICMMPE 2016) which was held from 23rd to 24th November, 2016 in Kuala Lumpur, Malaysia. The proceedings discuss genuine problems of joining technologies that are heart of manufacturing sectors. It discusses the findings of experimental and numerical works from soldering, arc welding to solid state joining technology that faced by current industry.

This book combines the contributions of experts in the field to describe the behavior of various
materials, micromechanisms involved during processing, and the optimization of cold-spray technology. It spans production, characterization, and applications including wear resistance, fatigue, life improvement, thermal barriers, crack repair, and biological applications. Cold spray is an innovative coating technology based on the kinetic energy gained by particles sprayed at very high pressures. While the technique was developed in the 1990s, industrial and scientific interest in this technology has grown vastly in the last ten years. Recently, many interesting applications have been associated with cold-sprayed coatings, including wear resistance, fatigue life improvement, thermal barriers, biological applications, and crack repair. However, many fundamental aspects require clarification and description.

This book presents some developments in the field of welding technology. It starts with classical welding concepts, covering then new approaches. Topics such as ultrasonic welding, robots welding, welding defects and welding quality control are presented in a clear, didactic way. Lower temperature metal-joining techniques such as brazing and soldering are highlighted as well.

This contributed volume contains the research results of the Cluster of Excellence “Integrative Production Technology for High-Wage Countries”, funded by the German Research Society (DFG). The approach to the topic is genuinely interdisciplinary, covering insights from fields such as engineering, material sciences, economics and social sciences. The book contains coherent deterministic models for integrative product creation chains as well as harmonized cybernetic models of production systems. The content is structured into five sections: Integrative Production Technology, Individualized Production, Virtual Production Systems, Integrated Technologies, Self-Optimizing Production Systems and Collaboration Productivity. The target audience primarily comprises research experts and practitioners in the field of production engineering, but the book may also be beneficial for graduate students.

Issues in Structural and Materials Engineering: 2013 Edition is a ScholarlyEditions™ book that delivers timely, authoritative, and comprehensive information about Computer Engineering. The editors have built Issues in Structural and Materials Engineering: 2013 Edition on the vast information databases of ScholarlyNews™. You can expect the information about Computer Engineering in this book to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Issues in Structural and Materials Engineering: 2013 Edition has been produced by the world’s leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at http://www.ScholarlyEditions.com/.

This book comprises select proceedings of the International Conference on Design, Materials, Cryogenics and Constructions (ICDMC 2019). The chapters cover latest research in different areas of mechanical engineering such as additive manufacturing, automation in industry and agriculture, combustion and emission control, CFD, finite element analysis, and engineering design. The book also focuses on cryogenic systems and low-temperature materials for cost-effective and energy-efficient solutions to current challenges in the manufacturing sector. Given its contents, the book can be useful for students, academics, and practitioners.

This book covers recent research and trends in Manufacturing Engineering. The chapters emphasize different aspects of the transformation from materials to products. It provides the reader with fundamental materials treatments and the integration of processes. Concepts such as green and lean manufacturing are also covered in this book.
This collection presents fundamentals and the current status of friction stir welding (FSW) and solid-state friction stir processing of materials, and provides researchers and engineers with an opportunity to review the current status of the friction stir related processes and discuss the future possibilities. Contributions cover various aspects of friction stir welding and processing including their derivative technologies. Topics include but are not limited to: derivative technologies; high-temperature lightweight applications; industrial applications; dissimilar alloys and/or materials; controls and nondestructive examination; simulation; characterization.

Thermal processes are key manufacturing steps in producing durable and useful products, with solidification, welding, heat treating, and surface engineering being primary steps. These papers represent the latest state-of-the-art in thermal process modeling. The breadth of topics covers the depth of the industry.

Mechanics of Materials in Modern Manufacturing Methods and Processing Techniques provides a detailed overview of the latest developments in the mechanics of modern metal forming manufacturing. Focused on mechanics as opposed to process, it looks at the mechanical behavior of materials exposed to loading and environmental conditions related to modern manufacturing processes, covering deformation as well as damage and fracture processes. The book progresses from forming to machining and surface-treatment processes, and concludes with a series of chapters looking at recent and emerging technologies. Other topics covered include simulations in autofrettage processes, modeling strategies related to cutting simulations, residual stress caused by high thermomechanical gradients and pultrusion, as well as the mechanics of the curing process, forging, and cold spraying, among others. Some non-metallic materials, such as ceramics and composites, are covered as well. Synthesizes the latest research in the mechanics of modern metal forming processes Suggests theoretical models and numerical codes to predict mechanical responses Covers mechanics of shot peening, pultrusion, hydroforming, magnetic pulse forming Considers applicability of different materials and processes for optimum performance

Issues in Technology Theory, Research, and Application: 2013 Edition is a ScholarlyEditions™ book that delivers timely, authoritative, and comprehensive information about Ocean Technology. The editors have built Issues in Technology Theory, Research, and Application: 2013 Edition on the vast information databases of ScholarlyNews,™ You can expect the information about Ocean Technology in this book to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Issues in Technology Theory, Research, and Application: 2013 Edition has been produced by the world's leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at http://www.ScholarlyEditions.com/.

This book describes the fundamentals of residual stresses in friction stir welding and reviews the data reported for various materials. Residual stresses produced during manufacturing processes lead to distortion of structures. It is critical to understand and mitigate residual stresses. From the onset of friction stir welding, claims have been made about the lower magnitude of residual stresses. The lower residual stresses are partly due to lower peak temperature and shorter time at temperature during friction stir welding. A review of residual stresses that result from the friction stir process and strategies to mitigate it have been presented. Friction stir welding can be combined with additional in-situ and ex-situ manufacturing steps to lower the final residual stresses. Modeling of residual stresses highlights the relationship between clamping constraint and development of distortion. For many applications, management of residual stresses can be critical for qualification of component/structure. Reviews magnitude of residual stresses in various metals and alloys
Discusses mitigation strategies for residual stresses during friction stir welding. Covers fundamental origin of residual stresses and distortion.

Friction stir welding (FSW) is a highly important and recently developed joining technology that produces a solid phase bond. It uses a rotating tool to generate frictional heat that causes material of the components to be welded to soften without reaching the melting point and allows the tool to move along the weld line. Plasticized material is transferred from the leading edge to trailing edge of the tool probe, leaving a solid phase bond between the two parts. Friction stir welding: from basics to applications reviews the fundamentals of the process and how it is used in industrial applications.

Part one discusses general issues with chapters on topics such as basic process overview, material deformation and joint formation in friction stir welding, inspection and quality control and friction stir welding equipment requirements and machinery descriptions as well as industrial applications of friction stir welding. A chapter giving an outlook on the future of friction stir welding is included in Part one. Part two reviews the variables in friction stir welding including residual stresses in friction stir welding, effects and defects of friction stir welds, modeling thermal properties in friction stir welding and metallurgy and weld performance. With its distinguished editors and international team of contributors, Friction stir welding: from basics to applications is a standard reference for mechanical, welding and materials engineers in the aerospace, automotive, railway, shipbuilding, nuclear and other metal fabrication industries, particularly those that use aluminium alloys.

Reviews the variables involved in friction stir welding including residual stresses, effects and defects of friction stir welds, modeling thermal properties, metallurgy and weld performance.

Computational Methods and Production Engineering: Research and Development is an original book publishing refereed, high quality articles with a special emphasis on research and development in production engineering and production organization for modern industry. Innovation and the relationship between computational methods and production engineering are presented. Contents include: Finite Element method (FEM) modeling/simulation; Artificial neural networks (ANNs); Genetic algorithms; Evolutionary computation; Fuzzy logic; neuro-fuzzy systems; Particle swarm optimization (PSO); Tabu search and simulation annealing; and optimization techniques for complex systems. As computational methods currently have several applications, including modeling manufacturing processes, monitoring and control, parameters optimization and computer-aided process planning, this book is an ideal resource for practitioners. Presents cutting-edge computational methods for production engineering. Explores the relationship between applied computational methods and production engineering. Presents new innovations in the field. Edited by a key researcher in the field.

The primary objective of this research is to use the commercially available finite element software ABAQUS/Explicit to develop a three-dimensional, fully coupled thermo-mechanical model of the plunge phase of a modified refill Friction Stir Spot Welding (FSSW) process. In the numerical model, the plates being joined are modeled as a single deformable body while the pin and clamp are assumed as rigid bodies. The dimensions of the tool were provided by Advanced Material Processing and Joining (AMP) Laboratory of SDSM & T. Temperature-dependent material properties of Aluminum 7075-T6 representing an elastic-perfectly plastic constitutive relation were used in the model. An Arbitrary Lagrangian-Eulerian (ALE) formulation together with an adaptive meshing strategy was used for the analysis. In addition, a contact algorithm with a modified Coulomb friction law was employed to take into account the interaction between the tool and the plate material. The model was used to predict temperature distribution, stresses, and deformations in the...
plates being spot welded. An experimental study was conducted to validate the temperatures predicted by the model at selected locations close to the path of the motion of the tool. In addition, the material flow predicted by the model was compared against experimental results published in the literature. The simulation results were in good agreement with the temperatures measured in the experiment. Also, the model was able to predict in a reasonable fashion the mechanical response of the plate material. Improvements are required in the model to remove some of the assumptions made and to refine the value of key parameters that control the numerical results. In addition to the FEM model and validation experiment mentioned above, preliminary flow visualization experiments were also conducted by inserting markers into the bottom plate in order to visualize the material flow in the vicinity of the pin during the plunge phase of the process. Three different marker materials were chosen for the experiments and the flow patterns observed were compared to select the appropriate marker material for a more comprehensive experimental study. Based on the results, inferences were made regarding the path of motion of the plate material during the process.

This book is a printed edition of the Special Issue Friction Stir Welding and Processing in Alloy Manufacturing that was published in Metals

Comprehensive Materials Processing provides students and professionals with a one-stop resource consolidating and enhancing the literature of the materials processing and manufacturing universe. It provides authoritative analysis of all processes, technologies, and techniques for converting industrial materials from a raw state into finished parts or products. Assisting scientists and engineers in the selection, design, and use of materials, whether in the lab or in industry, it matches the adaptive complexity of emergent materials and processing technologies. Extensive traditional article-level academic discussion of core theories and applications is supplemented by applied case studies and advanced multimedia features. Coverage encompasses the general categories of solidification, powder, deposition, and deformation processing, and includes discussion on plant and tool design, analysis and characterization of processing techniques, high-temperatures studies, and the influence of process scale on component characteristics and behavior. Authored and reviewed by world-class academic and industrial specialists in each subject field Practical tools such as integrated case studies, user-defined process schemata, and multimedia modeling and functionality Maximizes research efficiency by collating the most important and established information in one place with integrated applets linking to relevant outside sources

Friction-stir welding (FSW) is a solid-state joining process primarily used on aluminum, and is also widely used for joining dissimilar metals such as aluminum, magnesium, copper and ferrous alloys. Recently, a friction-stir processing (FSP) technique based on FSW has been used for microstructural modifications, the homogenized and refined microstructure along with the reduced porosity resulting in improved mechanical properties. Advances in friction-stir welding and processing deals with the processes involved in different metals and polymers, including their microstructural and mechanical properties, wear and corrosion behavior, heat flow, and simulation. The book is structured into ten chapters, covering applications of the technology; tool and welding design; material and heat flow; microstructural evolution; mechanical properties; corrosion behavior and wear properties. Later chapters cover mechanical alloying and FSP as a welding and casting repair technique; optimization and simulation of artificial neural networks; and FSW and FSP of polymers. Provides studies of the microstructural, mechanical, corrosion and wear properties of friction-stir welded and processed materials Considers heat generation, heat flow and material flow Covers simulation of FSW/FSP and use of artificial neural network in FSW/FSP

This volume presents a selection of papers from the 2nd International Conference on Computational Methods in Manufacturing (ICCMM 2019). The papers cover the recent advances in computational methods for simulating various manufacturing processes like machining, laser welding, laser
bending, strip rolling, surface characterization and measurement. Articles in this volume discuss both the development of new methods and the application and efficacy of existing computational methods in manufacturing sector. This volume will be of interest to researchers in both industry and academia working on computational methods in manufacturing.

This volume comprises select proceedings of the 7th International and 28th All India Manufacturing Technology, Design and Research conference 2018 (AIMTDR 2018). The papers in this volume discuss simulations based on techniques such as finite element method (FEM) as well as soft computing based techniques such as artificial neural network (ANN), their optimization and the development and design of mechanical products. This volume will be of interest to researchers, policy makers, and practicing engineers alike.

This book focuses on numerical simulations of manufacturing processes, discussing the use of numerical simulation techniques for design and analysis of the components and the manufacturing systems. Experimental studies on manufacturing processes are costly, time consuming and limited to the facilities available. Numerical simulations can help study the process at a faster rate and for a wide range of process conditions. They also provide good prediction accuracy and deeper insights into the process. The simulation models do not require any pre-simulation, experimental or analytical results, making them highly suitable and widely used for the reliable prediction of process outcomes. The book is based on selected proceedings of AIMTDR 2016. The chapters discuss topics relating to various simulation techniques, such as computational fluid dynamics, heat flow, thermo-mechanical analysis, molecular dynamics, multibody dynamic analysis, and operational modal analysis. These simulation techniques are used to: 1) design the components, 2) to investigate the effect of critical process parameters on the process outcome, 3) to explore the physics of the process, 4) to analyse the feasibility of the process or design, and 5) to optimize the process. A wide range of advanced manufacturing processes are covered, including friction stir welding, electro-discharge machining, electro-chemical machining, magnetic pulse welding, milling with MQL (minimum quantity lubrication), electromagnetic cladding, abrasive flow machining, incremental sheet forming, ultrasonic assisted turning, TIG welding, and laser sintering. This book will be useful to researchers and professional engineers alike.

This book lays out the fundamentals of friction stir welding and processing and builds toward practical perspectives. The authors describe the links between the thermo-mechanical aspects and the microstructural evolution and use of these for the development of the friction stir process as a broader metallurgical tool for microstructural modification and manufacturing. The fundamentals behind the practical aspects of tool design, process parameter selection and weld related defects are discussed. Local microstructural refinement has enabled new concepts of superplastic forming and enhanced low temperature forming. The collection of friction stir based technologies is a versatile set of solid state manufacturing tools.

This is the first-ever book on smoothed particle hydrodynamics (SPH) and its variations, covering the theoretical background, numerical techniques, code implementation issues, and many novel and interesting applications. It contains many appealing and practical examples, including free surface flows, high explosive detonation and explosion, underwater explosion and water mitigation of explosive shocks, high velocity impact and penetration, and multiple scale simulations coupled with the molecular dynamics method. An SPH source code is provided and coupling of SPH and molecular dynamics is discussed for multiscale simulation, making this a friendly book for readers and SPH users.

The object of the work is to develop a three dimensional finite element model for plunge and three quarter retract phases of the modified refill Friction Stir Spot Welding process and also conduct
qualitative experimental studies using markers to visualize the material flow in the process being modeled. An isothermal model is developed to understand the formulations and techniques required to simulate the process. As a preliminary effort, finite element model is developed by defining material properties at two different temperatures for plate. The model, based on a solid mechanics approach, was developed using the commercial finite element software ABAQUS/Explicit. The isothermal model was employed to obtain the deformations, stresses and strains induced in the plates being spot welded. The numerical model developed assumes the pin, shoulder and clamp as rigid in nature, while the plate material is modeled as a 3-D deformable body. The dimensions provided by the Advanced Materials Processing and Joining Laboratory, SDSM & T are used to build the numerical model. Virtual tracers were included in the FEM model to visualize the material flow in the vicinity of pin. Qualitative experimental studies were performed using markers to visualize the material flow and also to validate the numerical model. Three full plunge tests were performed by placing marker rod at different locations with respect to pin's circumference. The process parameters used in the experiment were similar to the numerical model. Reaction forces on the pin and material flow are the desired outputs from this research work. The reaction forces from the numerical model were compared to the experimental values and found to be closer. The results from the numerical model are quite promising in nature. The numerical model was able to predict the flash formation during FSSW process. A comparison of results for material flow visualization using virtual tracers provided by the simulations with the experimental data shows that it gives an acceptable approximation but additional refinement of the model is needed.

Manufacturing industry has been one of the key drivers for recent rapid global economic development. Globalisation of manufacturing industries due to distributed design and labour advantage leads to a drive and thirst for technological advancements and expertise in the fields of advanced design and manufacturing. This development results in many economical benefits to and improvement of quality of life for many people all over the world. This rapid development also creates many opportunities and challenges for both industrialists and academics, as the design requirements and constraints have completely changed in this global design and manufacture environment. Consequently the way to design, manufacture and realise products have changed as well. More and more design and manufacture tasks can now be undertaken within computer environment using simulation and virtual reality technologies. These technological advancements hence support more advanced product development and manufacturing operations in such a global design and manufacturing environment. In this global context and scenario, both industry and the academia have an urgent need to equip themselves with the latest knowledge, technology and methods developed for engineering design and manufacture.

This book offers a snapshot of recent developments in improving the properties and performance of engineering materials and structures. It discusses modeling properties related to classical mechanical, thermal, electrical and optical fields as well as those related to surface-specific quantities (e.g. roughness, wear and modifications due to surface coatings). The material types presented range from classical metals and synthetic materials to composites. Competitiveness due to cost efficiency (e.g. lighter structures and the corresponding fuel savings for transportation systems) and sustainability (e.g. recyclability or reusability) are the driving factors for engineering developments. The outcomes of these efforts are difficult to be accurately monitored due to the ongoing evaluation cycles.

This edited book contains extended research papers from AIMTDR 2014. This includes recent research work in the fields of friction stir welding, sheet forming, joining and forming, modeling and simulation, efficient prediction strategies, micro-manufacturing, sustainable and green manufacturing issues etc. This will prove useful to students, researchers and practitioners in the field of materials forming and manufacturing.
This book covers a variety of topics in mechanics, with a special emphasis on material mechanics. It reports on fracture mechanics, fatigue of materials, stress-strain behaviours, as well as transferability problems and constraint effects in fracture mechanics. It covers different kind of materials, from metallic materials such as ferritic and austenitic steels, to composites, concrete, polymers and nanomaterials. Additional topics include heat transfer, quality control and reliability of structures and components. Furthermore, the book gives particular attention to new welding technologies such as STIR welding and spray metal coating, and to novel methods for quality control, such as Taguchi design, fault diagnosis and wavelet analysis. Based on the 2015 edition of the Algerian Congress of Mechanics (Congrès Algérien de Mécanique, CAM), the book also covers energetics, in terms of simulation of turbulent reactive flow, behaviour of supersonic jet, turbulent combustion, fire induced smoke layer, and heat and mass transfer, as well as important concepts related to human reliability and safety of components and structures. All in all, the book represents a complete, practice-oriented reference guide for both academic and professionals in the field of mechanics.

This book will summarize research work carried out so far on dissimilar metallic material welding using friction stir welding (FSW). Joining of dissimilar alloys and materials are needed in many engineering systems and is considered quite challenging. Research in this area has shown significant benefit in terms of ease of processing, material mixing, and superior mechanical properties such as joint efficiencies. A summary of these results will be discussed along with potential guidelines for designers. Explains solid phase process and distortion of work piece Addresses dimensional stability and repeatability Addresses joint strength Covers metallurgical properties in the joint area Covers fine microstructure Introduces improved materials use (e.g., joining different thicknesses) Covers decreased fuel consumption in light weight aircraft Addresses automotive and ship applications

Refill Friction stir spot welding (RFSSW) produces a solid-state lap joint between sheet metals, preferably aluminum alloys, without leaving behind an exit hole in the workpiece. This joining technique was derived from friction stir spot welding (FSSW). RFSSW has been demonstrating a potential for replacing conventional joining techniques, such as riveting, resistance spot welding, and fastening. The goal of the research is to compare stress distributions and failure mechanisms of the joints produced by RFSSW and riveting. The experimentation involved finite element simulations of static loads applied to RFSSW coupons and riveted coupons in the directions of lap shear and cross tension. To validate the simulation results, actual coupons were produced and mechanically tested. The study used a robotic RFSSW system developed by Kawasaki Heavy Industries (KHI) for producing RFSSW coupons. The stress distributions estimated by the finite element simulations were in a good agreement with the failure mechanisms demonstrated by actual coupons during mechanical tests. Keywords: Refill Friction Stir Spot Welding, Riveting, Aerospace, FEA, ABAQUS

The objective of this work is to develop simplified finite element models and also conduct experiments to study the structural performance of sandwich structures made with Friction Stir Welding (FSW) or re-fill friction stir spot welding (FSSW) along with Superplastic forming (SPF). The models were developed using the commercial finite element software ABAQUS/Standard. The main objective of this research is to use computer simulations and experimental validation to compare the mechanical response of the three sandwich structures under consideration. A sandwich structure consists of stiff and strong face sheets and a low density core. Due to their high stiffness and strength to weight rations, sandwich structures are used in space applications, nuclear, oil and chemical industries. The SDSM & T AMP Center used FSW to manufacture sandwich structures with round tubing cores and in collaboration with PNNL Used FSW or FSSW in conjunction with SPF to produce two corrugated sandwich structures. The dimensions measured from the actual sandwich panels provided by the AMP center and PNNL are used to build numerical models. Two
types of experiments, three point bend test and compression test, were carried out as a part of this thesis. The first experiment was used to validate the static numerical model and the second experiment was used to find the critical load for buckling of sandwich structures considered. The results predicted by the numerical models are validated with the results obtained from the experiments. The numerical results for the static analysis are in good agreement with the experimental ones and the buckling results are over predicted when compared with the compression test results. Three types of sandwich structures are considered and the static, dynamic and buckling response is compared numerically against that of a monolithic plate made of same material and having the same weight. Based on the numerical results sandwich structures corresponding to the 2-D core and round tubing have the potential to be used instead of monolithic plates.

This volume presents selected papers from the 3rd International Conference on Mechanical, Manufacturing and Process Plant Engineering (ICMMPE 2017) which was in Penang, Malaysia, 22nd–23rd November 2017. The proceedings discuss genuine problems covering various topics of mechanical, manufacturing, and Process Plant engineering.

Fatigue in Friction Stir Welding provides knowledge on how to design and fabricate high performance, fatigue resistance FSW joints. It summarizes fatigue characterizations of key FSW configurations, including butt and lap-shear joints. The book's main focus is on fatigue of aluminum alloys, but discussions of magnesium, steel, and titanium alloys are also included. The FSW process-structure-fatigue performance relationships, including tool rotation, travel speeds, and pin tools are covered, along with sections on extreme fatigue conditions and environments, including multiaxial, variable amplitude, and corrosion effects on fatigue of the FSW. From a practical design perspective, appropriate fatigue design guidelines, including engineering and microstructure-sensitive modeling approaches are discussed. Finally, an appendix with numerous representative fatigue curves for design and reference purposes completes the work. Provides a comprehensive characterization of fatigue behavior for various FSW joints and alloy combinations, along with an in-depth presentation on crack initiation and growth mechanisms Discusses modeling strategies and design recommendations, along with experimental data for reference purposes.

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