Friction Stir Welding With Abaqus

This book reports on cutting-edge research in the broad fields of mechanical engineering and mechanics. It describes innovative applications and research findings in applied and fluid mechanics, design and manufacturing, thermal science and materials. A number of industrially relevant recent advances are also highlighted. All papers were carefully selected from contributions presented at the International Conference on Advances in Mechanical Engineering and Mechanics, ICAMEM2019, held on December 16–18, 2019, in Hammamet, Tunisia, and organized by the Laboratory of Electromechanical Systems (LASEM) at the National School of Engineers of Sfax (ENIS) and the Tunisian Scientific Society (TSS), in collaboration with a number of higher education and research institutions in and outside Tunisia.

Forest trees cover 30% of the earth's land surface, providing renewable fuel, wood, timber, shelter, fruits, leaves, bark, roots, and are source of medicinal products in addition to benefits such as carbon sequestration, water shed protection, and habitat for 1/3 of terrestrial species. However, the genetic analysis and breeding of trees has lagged behind that of crop plants. Therefore, systematic conservation, sustainable improvement and pragmatic utilization of trees are global priorities. This book provides comprehensive and up to date information about tree characterization, biological understanding, and improvement through biotechnological and molecular tools.

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.

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.

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 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.

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

This book provides an in-depth treatment of the study of the stability of engineering structures. Contributions from internationally recognized leaders in the field ensure a wide coverage of engineering disciplines in which structural stability is of importance, in particular the experimental, analytical and numerical modelling of structural stability applied to aeronautical, civil and marine structures. This second volume in buckling and postbuckling structures builds on the first, and reports on the development of fast semi-analytical methods for the rapid characterization of postbuckling structures; optimization approaches for the design of stiffened composite panels, and a discourse on imperfection sensitivity. This book will be a particularly useful reference to professional engineers, graduate students and researchers interested in structural stability.

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 presents selected papers from the 5th International Conference on Mechanical, Manufacturing and Plant Engineering (ICMMPE 2019), held in Kuala Lumpur, Malaysia. It highlights the latest advances in the area, brings together researchers and professionals in the field and provides a valuable platform for exchanging ideas and fostering collaboration. Joining technologies could be change to manufacturing technologies. Addressing real-world problems concerning joining technologies that are at the heart of various manufacturing sectors, the respective papers present the outcomes of the latest experimental and numerical work on problems in soldering, arc welding and solid-state joining technologies. technologies. technologies. technologies. technologies. technologies. technologies. technologies. technologies. technologies. technologies.

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.

Increasing concern with fuel consumption leads to widespread interest in lightweight structures for transportation vehicles. Several competing technologies are available for the structural connections of these structures, namely welding, mechanical fastening / riveting, and adhesive technologies. Arranged in a single volume, this work is to presents state-of-the-art discussions of those aspects and processes presenting greater novelty whilst simultaneously keeping wide applicability potential and interest. The topics chosen have the common feature of being of currently applied in lightweight structures, and one of the characteristics of this work is bringing together relevant state-of-the-art information usually presented in separate publications specializing in a single technology. The book provides discussions and examples of concrete applications, so that it appeals to researchers and designers and engineers involved in the design and fabrication of lightweight structures.

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Collection of selected, peer reviewed papers from the 2013 International Conference on Mechanical, Automotive and Materials Engineering (CMAME 2013), July 26-27, 2013, Hong Kong. The 89 papers are grouped as follows: Chapter 1: Materials Science, Structural Composites, Materials Processing; Chapter 2: Nanomaterials Science; Chapter 3: Mechanical Properties of Materials, Deformation, Coating Engineering; Chapter 4: Computing Methods and Algorithms; Chapter 5: Experimental Methods and Studies; Chapter 6: Design, Modelling, Simulation and Optimization Technologies, CAD Applications; Chapter 7: Automation and Control, Detection and Tracking Technologies; Chapter 8: Advanced Technologies in Industry, Safety and Assessment.

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Friction stir welding (FSW) is a solid state joining process performed by rotating a cylindrical tool with a short protrusion between the two metal pieces to be joined. The combination of frictional and deformation heating leads to the consolidation of the joint. This welding method is rapidly growing in popularity in many applications, particularly in aluminum alloys for transportation vehicle (rail cars, ships) and bridge applications. Across North America, over 150,000 bridges have been identified as "structurally deficient" or "functionally obsolete". Since FSW has the potential to have a positive influence on their durability and economics, the Aluminum Association of Canada (AAC) has identified the possibility of replacing promoting aluminum bridge decks as a means of replacing existing deficient concrete decks. However, currently available codes and guidelines for aluminum welded joints only address structures made with conventional welding methods. Therefore, bridge designers are lacking the necessary knowledge to use FSW joints in their designs. The main objective of this thesis is to present a fatigue testing study to support the development of improved "performance-based" code provisions for the quality control and fatigue design of FSW joints by examining the durability of FSW joints with prescribed flaws. In order to obtain the experimental results, various intentionally flawed aluminum FSW samples were fabricated for fatigue testing under constant amplitude (CA) and simulated in-service variable amplitude (VA) loading conditions. A statistical analysis of the results has been performed to assess the influence of the various defect types. It has also been shown how finite element (FE) analysis using the software ABAQUS can be used to assess the influence of the defects on the local stresses within the welded joints. Lastly, it is shown how the fatigue performance of the welds can be predicted using linear elastic fracture mechanics (LEFM). The results of this research will contribute to an improved understanding of the behaviour of imperfect FSW joints under fatigue loading conditions, which simulate in-service vehicular bridge VA loading. The main conclusions of this research include the following: 1) The worst fatigue lives were observed in the specimens with "kissing bond" defects at the weld root (on the order of approximately 1 mm in depth), 2) toe flash, undercut, and worm hole defects, as well as surface improvement by polishing were seen to have a much lower influence on fatigue performance, 3) a novel "lap joint" specimen simulating an extruded bridge deck joint was also observed to fail at the root at a nominal stress level lower than that of a properly-welded butt joint.

Nowadays, it is quite easy to see various applications of fibrous composites, functionally graded materials, laminated composite, nano-structured reinforcement, morphing composites, in many engineering fields, such as aerospace, mechanical, naval and civil engineering. The increase in the use of composite structures in different engineering practices justify the present international meeting where researches from every part of the globe can share and discuss the recent advancements regarding the use of standard structural components within advanced applications such as buckling, vibrations, repair, reinforcements, concrete, composite laminated materials and more recent metamaterials. For this reason, the establishment of this 19th edition of International Conference on Composite Structures has appeared appropriate to continue what has been begun during the previous editions. ICCS wants to be an occasion for many researchers from each part of the globe to meet and discuss about the recent advancements regarding the use of composite structures, sandwich panels, nanotechnology, bio-composites, delamination and fracture, experimental methods, manufacturing and other countless topics that have filled many sessions during this conference. As a proof of this event, which has taken place in Porto (Portugal), selected plenary and keynote lectures have been collected in the present book.

Die Reduktion des Fahrzeuggewichtes durch Leichtbau stellt eine effektive Möglichkeit zur Vergrößerung der Reichweite von E-Mobilen sowie zur Verringerung der Emissionen bei konventionellen Kraftfahrzeugen dar. Sowohl beim konstruktiven als auch beim Werkstoff-Leichtbau kommt dabei der Fügetechnologie eine entscheidende Rolle zu. Das hochfeste schweißtechnische Fügen niederlegierter ferritischer Stähle, wie sie im Karosseriebau eingesetzt werden, wird heute mit verschiedenen Schmelz- und Pressschweißverfahren wie z. B. dem Laser- oder Widerstandspunktschweißen beherrscht. Beim Verschweißen von hochfesten Aluminiumwerkstoffen mit heute gängigen Schweißprozessen kann es jedoch an der Fügestelle zu signifikanten Einbußen der Festigkeit kommen. Die festigkeitssteigernden Mechanismen im Aluminium werden durch die hohe Wärmeeinbringung beim Aufschmelzen reduziert bzw. gehen verloren. Bei der mit der Erstarrung einhergehenden Gefügeneubildung können diese Mechanismen nicht mehr oder nur noch in geringerem Maße aktiviert werden. Darüber hinaus stellen, je nach chemischer Zusammensetzung der Aluminiumlegierung, Heißrisse sowie im speziellen Fall des Widerstandpunktschweißens der hohe Elektrodenverschleiß generelle Probleme dar. Um diese mit dem Aufschmelzen bzw. Erstarren der hochfesten Aluminiumlegierungen zusammenhängenden Probleme zu lösen bzw. vielmehr zu umgehen, wurde 1991 am The Welding Institute (GB) das Rührreibschweißen entwickelt. Dabei handelt es sich um ein spezielles Pressschweißverfahren, bei dem der Werkstoff vollständig in fester Phase verbleibt. Im Gegensatz zu herkömmlichen Reibschweißprozessen, wie z. B. dem Linear- oder Rotationsreibschweißen, wird dabei allerdings keine Relativbewegung zwischen den zu fügenden Bauteilen oder Werkstoffen benötigt. Vielmehr wird die Reibarbeit durch ein rotierendes Schweißwerkzeug eingebracht, das in den Fügespalt eingepresst und entlang desselben verfahren wird. Durch den

Materialtransport um das rotierende Werkzeug bzw. dessen Pin wird die Schweißnaht hergestellt. Aufgrund dieser Besonderheit, dass der Werkstoff in fester Phase verbleibt, sind neben hochfesten Aluminiumverbindungen auch Mischverbindungen möglich. Solche Mischverbindungen sind schmelzmetallurgisch nicht oder nur eingeschränkt möglich. Hierzu zählen insbesondere stoffschlüssige Aluminium-Stahl-Mischverbindungen, die für den ökonomischen Hybrid-Leichtbau der Karosserie von besonderem Interesse sind. Die Festigkeit solcher Verbindungen kann allerdings durch spröde intermetallische Verbindungen stark begrenzt werden. Dies stellt eine der technologischen Grundherausforderungen dieser Arbeit dar. Daher soll diese Arbeit dazu beitragen, den Rührreibschweißprozess als industrielles Fertigungsverfahren für hochfeste Aluminium- und Aluminium-Stahl-Hybrid-Verbindungen, besonders für den Karosseriebau mit seinen spezifischen Anforderungen, zu etablieren. Um den Prozess besser zu verstehen und die Auswirkungen auf die resultierenden Festigkeitseigenschaften quantifizieren zu können, werden in dieser Arbeit vorrangig experimentelle, aber auch numerische Ansätze entwickelt. Des Weiteren ist es das Ziel, die gewonnenen Erkenntnisse in Form von Prozesserweiterungen, -verbesserungen oder -abwandlungen für industrielle Prozesse nutzbar zu machen. Da die in diesem Zusammenhang entwickelten Lösungen teilweise deutlich über den aktuellen Stand der Technik hinausgehen, wurden während dieser Arbeit eine hohe Zahl an Erfindungen mit nachfolgenden Patentanmeldungen gemacht (siehe Tabelle 8.1). Grundlage des ersten Teils der Arbeit ist die Entwicklung geometrisch neuartiger Schweißnahtkonfigurationen samt zugehörigem Herstellungsprozess, um Aluminium- und Stahlbleche unterschiedlichster Dicke hochfest fügen zu können. Hierbei wird explizit auf die Anforderungen für eine spätere Nutzung der Mischverbindungen in hybriden Tailor Welded Blanks (TWB) eingegangen. Hierzu gehört besonders die Anforderung, die Schweißnaht als Stumpfstoß und einseitig eben auszuführen. Ein weiteres Erfordernis besteht darin, dass die Tailor Welded Blanks in Tiefziehprozessen umformbar sind und dabei nicht im Bereich der Schweißnaht aufreißen. Zwei unterschiedliche Lösungen wurden hierzu entwickelt: Bei der ersten Ausführung wird das höherfeste, aber dünnere Stahlblech entlang der Schweißnaht umgebördelt, um so eine Vergrößerung des Anbindungsquerschnittes zu realisieren. Da dies einen zusätzlichen Bearbeitungsschritt erfordert und insbesondere hochfeste Stähle nicht rissfrei aufeinander umgelegt werden können, wurde im Verlauf dieser Arbeit eine zweite Lösung entwickelt. Hierbei wird ein Rührreibschweißwerkzeug mit abgestuftem Schweißstift verwendet, um eine kombinierte Überlapp- und Stumpfstoßverbindung herzustellen. Dabei führt der untere zylindrische Abschnitt des Schweißstiftes eine Stumpfverschweißung zwischen Stahl und Aluminium aus. Der stirnseitige Abschnitt der Stufe des Schweißstifts erzeugt gleichzeitig eine Überlappverbindung zwischen den beiden Werkstoffen. Der Vergleich beider entwickelter Lösungen mit dem Stand der Technik wurde anhand der automobiltypischen Werkstoffkombination EN AW-6016-T4 2,0 mm (Aluminium-Magnesium-Silizium-Legierung) / HC340LAD 1,0 mm (mikrolegierter Feinkornstahl) durchgeführt. Dabei zeigt sich besonders in den Schwingfestigkeitsuntersuchungen eine signifikante Überlegenheit der kombinierten Stumpf- und Überlappverbindung gegenüber dem Stand der Technik. Kombinationen von Aluminium und Stahl, bei denen das Produkt von Blechdicke und Festigkeit seitens des Aluminiums etwas größer ist als das des Stahlblechs, zeigen in Napfziehversuchen Umformergebnisse ohne Aufreißen der Schweißnaht. Kombinationen, bei denen das Produkt von Blechdicke und Festigkeit seitens des Stahls größer war, zeigen auch nach Optimierung der Schweißparameter eine signifikante Dehnungslokalisierung mit nachfolgender Rissbildung in der WEZ des Aluminiums. Für diesen Fall der Dehnungslokalisierung in der Schweißnaht wird für aushärtbare Legierungen, basierend auf dem Aluminium-Magnesium-Silizium-Dreistoffsystem (6000er), eine neuartige Wärmebehandlungsmethode entwickelt. Ausgangspunkt dafür sind systematische Untersuchungen des Auslagerungsverhaltens des Grundwerkstoffs bei unterschiedlichen Auslagerungstemperaturen, -dauern und Zwischenauslagerungszeiten. Ferner werden die Grenzen für das Auftreten von Rekristallisation für den Grundwerkstoff, vorgedehnten Werkstoff und gleichartigen Schweißverbindungen experimentell untersucht. Überdies werden sowohl das Wachstum der intermetallischen Phasen in Glühversuchen von Aluminium-Stahl-Rührreibschweißverbindungen als auch die Auswirkung auf die Verbindungsfestigkeit untersucht. Es zeigt sich, dass der dickenabhängige, festigkeitslimitierende Effekt dieser Grenzschicht sehr gut mit der von Weibull entwickelten Theorie erklärt werden kann. Die quantitative Beschreibung dieses Zusammenhangs ergibt, dass herkömmliche Lösungsglühprozesse, aufgrund der zur Erwärmung der Bauteile benötigten Zeiten, nicht zielführend sind. Die neu entwickelte Wärmebehandlungsmethode nutzt daher den Schweißprozess selbst als lokalen Lösungsglühprozess. Grundvoraussetzung hierfür ist, dass der Schweißprozess ausreichend schnell ausgeführt wird, sodass es währenddessen nicht zu einer Überalterung der festigkeitssteigernden Ausscheidungen kommt. Durch die deutlich längere, logistisch bedingte Raumtemperatur-Zwischenauslagerung des Grundwerkstoffs im Vergleich zur Schweißnaht spricht dieser deutlich langsamer auf eine Warmauslagerung bei vergleichsweise niederen Temperaturen an. Dies bedeutet, dass mit dieser Methode die Festigkeit der Schweißnaht durch Warmauslagerung gesteigert werden kann, ohne dass der Grundwerkstoff eine signifikante Festigkeitssteigerung erfährt. Für die Legierung EN AW-6016 werden Prozessdiagramme zur Ermittlung der minimal notwendigen Warmauslagerungsdauer entwickelt. Die Diagramme berücksichtigen dabei die Auslagerungstemperatur, die Dauer der Kaltauslagerung der Schweißnaht sowie den Nahtunterhang der Rührreibschweißnähte. Die Diagramme werden mittels gleichartiger Aluminium-Schweißnähte und Aluminium-Stahl-Mischverbindungen validiert. Der dritte und abschließende Teil dieser Arbeit beschäftigt sich mit der numerischen Modellierung des Rührreibschweißprozesses, um zukünftig numerische Prozessoptimierungen zur weiteren Steigerung der Festigkeit durchführen zu können. Anhand einer Literaturrecherche wird gezeigt, dass ein wesentliches Steigerungspotential hinsichtlich der Aussagekraft der Prozesssimulationen in den hierzu verwendeten Materialmodellen liegt. Hierzu werden die bislang in der Literatur bekannten Werkstoffmodelle daraufhin analysiert, wie gut diese die Fließspannung über die breiten Dehnraten-, Temperatur-, und Dehnungsbereiche abbilden, die beim Rührreibschweißen auftreten können. Da bekannte thermomechanische Werkstoffmodelle für andere Anwendungen wie z. B. ballistische Impacts oder Warmumformung entwickelt wurden, zeigt sich die Notwendigkeit für eine Neuentwicklung. Bei dieser Neuentwicklung wird bewusst ausschließlich auf Effekte eingegangen, die bereits in der Literatur bekannt sind und die für den Prozessbereich des Rührreibschweißens als relevant einzustufen sind. Das neu entwickelte Modell wird unter Berücksichtigung verschiedener Annahmen zum Werkstoffverhalten bei Temperaturwechseln als User-Subroutine für Abaqus/Explicit implementiert. Zur Bestimmung der benötigten Modellparameter werden mit einer Gleeble 2000 bei einem breiten Temperatur- und Dehnratenspektrum für die Werkstoffe Al 99,5, EN AW-5182, AlSi10Mg und EN AW-6016 Druckversuche durchgeführt. Das Materialmodell reduziert den Modellfehler bei der Anpassung der Versuchsergebnisse gegenüber bereits etablierten Materialmodellen erheblich. Hierdurch wird die Aussagekraft von Prozesssimulationen, die dieses Materialmodell gegenüber dem etablierten Johnson-Cook-Modell verwenden, erheblich gesteigert.

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 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 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.

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 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.

Friction Stir Welding and ProcessingASM International

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.

The numerical simulation of manufacturing processes and of their mechanical consequences is of growing interest in industry. However, such simulations need the modeling of couplings between several physical phenomena such as heat transfer, material transformations and solid or fluid mechanics, as well as to be adapted to numerical methodologies. This book gathers a state of the art on how to simulate industrial processes, what data are needed and what numerical simulation can bring. Assembling processes such as welding and friction stir welding, material removal processes, elaboration processes of composite structures, sintering processes, surface-finishing techniques, and thermo-chemical treatments are investigated. This book is the work of a group of researchers who have been working together in this field for more than 12 years. It should prove useful for both those working in industry and those studying the numerical methods applied to multiphysics problems encountered in manufacturing processes.

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, MRP & 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.

The disciplines of science and engineering rely heavily on the forecasting of prospective constraints for concepts that have not yet been proven to exist, especially in areas such as artificial intelligence. Obtaining quality solutions to the problems presented becomes increasingly difficult due to the number of steps required to sift through the possible solutions, and the ability to solve such problems relies on the recognition of patterns and the categorization of data into specific sets. Predictive modeling and optimization methods allow unknown events to be categorized based on statistics and classifiers input by researchers. The Handbook of Research on Predictive Modeling and Optimization Methods in Science and Engineering is a critical reference source that provides comprehensive information on the use of optimization techniques and predictive models to solve real-life engineering and science problems. Through discussions on techniques such as robust design optimization, water level prediction, and the prediction of human actions, this publication identifies solutions to developing problems and new solutions for existing problems, making this publication a valuable resource for engineers, researchers, graduate students, and other professionals.

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.

Volume is indexed by Thomson Reuters CPCI-S (WoS). This collection brings together 820 peer-reviewed papers, on Manufacturing and Design Science, aimed at promoting the development of design and manufacturing science, strengthening international academic cooperation and communications, and exchanging research ideas. It is divided into: Chapter 1 Frontiers in Manufacturing Science, Chapter 2: Frontiers in Design Science, Chapter 3: Frontiers in Mechanics and Materials, Chapter 4: Frontiers in Automation and Information.

The aim of the present research effort involves exploration of a new processing approach, "Tailored Preform Processing (TPP)" technology for net-shape manufacturing of monolithic structures for the transportation industry. The proposed technology combines friction stir welding (FSW) and forming in order to tailor the properties of the preform to meet design requirements and provide net-shape preforms, which can subsequently be turned into finished structural parts through light machining or other standard processes. TPP can provide several advantages including weight reduction, part count reduction, improved damage tolerance, improved material and energy utilization, and cost saving. The research focuses on understanding of the process behavior and the effects of various process parameters on the properties and integrity of the produced structure during different stages of the TPP approach. Objectives of the proposed work also include providing capability for robust process design, prediction and characterization of process-induced damage and properties of the finished structure. These objectives are accomplished through innovative solution to the Tailored Perform Processing problems using the presented experimental and virtual models. Finite Element Method was used to model 3-D friction stir welding and forming processes. Numerical model of friction stir welding was carried out using Fully Coupled-Temperature Displacement Analysis. Forming of the Tailor Welded Blanks was modeled using ABAQUS/Explicit followed by the Springback simulation using ABAQUS/ Standard. FEA models were used to investigate the process behavior and effects of various parameters on the properties and integrity of produced structure. An optimization scheme based on Genetic Algorithm is integrated with the numerical models to provide the optimal process conditions for quality and cost effective production.

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 insititutions.

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

The aim of this special volume is to give an overview of the historical background and present status of eco-materials processing and design for materials research, and to foresee future trends in the field. Serious global and environmental problems have led the materials manufacturing industries to monitor closely the formation and accumulation of carbon dioxide and other deleterious gases in the atmosphere, as well to reduce raw materials use and energy consumption and limit other factors which reflect the environmental impact of the industry.Volume is indexed by Thomson Reuters CPCI-S (WoS). The papers contained within cover topics such as room- and low-temperature synthesis, low-energy processing, aqueous synthesis and processing, the re-use and recycling of waste materials and the elimination of such hazardous materials as cadmium, mercury, lead and chromium which are restricted in use, in electronic components and automobile parts, under the European Committee RoHS guidelines. It is shown how the materials industries have addressed environmental concerns by investing in research on various novel materials in order to ensure safer and cleaner systems and processes.This thorough coverage will certainly make the book essential reading for all of those who care about conserving the world for the benefit of future generations. Addressing environmental concern within the materials manufacturing industries, the January 2009 symposium explores low-temperature synthesis, low-energy processing, aqueous synthesis and processing, the reuse and recycling of waste materials, and the elimination of such hazardous materials as cadmium, mercury, lead, and 6-valence chromium. The Asian contributors share recent research on high-performance materials, hybrid composites, nanostructure materials, biomaterials, photocatalysts, multifunction of materials, and porous materials. Topics of the 195 papers include adding gneiss to asphalt concrete mixtures, characterization of power plant bottom ash, the effects of filler on the properties of silicone rubber, the fabrication of clay foam ceramics, and the use of recycled calcium slag for clean steel refining.

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.

Despite the wide availability of literature on welding processes, a need exists to regularly update the engineering community on advancements in joining techniques of similar and dissimilar materials, in their numerical modeling, as well as in their sensing and control. In response to InTech's request to provide undergraduate and graduate students, welding engineers, and researchers with updates on recent achievements in welding, a group of 34 authors and co-authors from 14 countries representing five continents have joined to co-author this book on welding processes, free of charge to the reader. This book is divided into four sections: Laser Welding; Numerical Modeling of Welding Processes; Sensing of Welding Processes; and General Topics in Welding.