

Preface

Material forming and Joining are amongst the oldest manufacturing processes, that are in use till today to fabricate micro to macro components. While material forming involves mainly elastic and plastic deformation of materials to obtain desired change in shape, joining essentially is an assembly process to make large-sized or complex parts. The material and metallurgical properties undergo substantial change during these processes. Researchers try to understand these processes by experimental and computational means. Although experiment-based research is inevitable, there is a trend to supplement it with computational techniques based on sound theoretical principles.

The chapters in this book discuss some of the basic and advanced topics in material forming and joining, including problems on rolling, sheet metal forming, adhesive bonding, welding operations like submerged arc welding, friction stir welding, accumulative roll bonding, and magnetic pulse welding. These chapters are extended versions of peer reviewed manuscripts presented in 5th International and 26th All India Manufacturing Technology, Design and Research (AIMTDR) conference held during December 12–14, 2014 at Indian Institute of Technology Guwahati, India. In total, 53 authors from academia and industry have contributed to this book. The book will be useful for researchers and practicing engineers.

The book contains 18 chapters. They are on varied topics. Chapter “[An Efficient Inverse Method for Determining the Material Parameters and Coefficient of Friction in Warm Rolling Process](#)” deals with numerical modelling of warm rolling process for predicting the materials behaviour using an efficient inverse method. Chapter “[Incremental Sheet Forming \(ISF\)](#)” discusses incremental sheet forming. Chapter “[Effect of Yield Strength, Pre-strain and Curvature on Stiffness and Static Dent Resistance of Formed Panel](#)” discusses the influence of selected process parameters on the dent resistance of sheets. Chapter “[Formability Prediction and Springback Evaluation of Adhesive Bonded Steel Sheets](#)” describes how the springback and formability of base sheets can be controlled by adhesive bonding. Chapter “[Feasibility Study of Thermal Autofrettage Process](#)” proposes a method for achieving autofrettage that involves creating thermal gradient in the wall of the cylinder. Chapters “[Numerical Analysis of Warm Deep Drawing for Ti-6Al-4V](#)

Alloy”, “Springback and Formability Studies on Friction Stir Welded Sheets” and “Prediction of Formability of Bi-axial Pre-strained Dual Phase Steel Sheets Using Stress-based Forming Limit Diagram” present some of the recent research activities in sheet metal forming. The authors of chapter “Numerical Analysis of Warm Deep Drawing for Ti–6Al–4V Alloy” have predicted the warm deep drawing behaviour of a titanium alloy. In chapter “Springback and Formability Studies on Friction Stir Welded Sheets” controlling springback and formability of sheets using friction stir welding has been discussed. The stress based forming limit diagram has been used to predict the formability of dual phase steel in chapter “Prediction of Formability of Bi-axial Pre-strained Dual Phase Steel Sheets Using Stress Based Forming Limit Diagram”. The microforming of a particular sheet material has been discussed in chapter “Size Effect on Mechanical Behaviour of SS304”.

Chapters “Prediction of Weld Induced Angular Distortion of Single Sided and Double Sided Fillet Joints by SAW Process” and “Optimization of Process Parameters in Submerged Arc Welding Using Multi-objectives Taguchi Method” deal with the role of submerged arc welding process on the joint distortion and weld joint quality. Chapter “Monitoring of Weld Quality in Friction Stir Welding based on Spindle Speed and Motor Current Signals” presents real-time weld quality monitoring during friction stir welding using spindle speed and main motor current signals. The finite element modelling simulation of magnetic pulse welding of tubes is presented in chapter “Coupled Electromagnetic–Structural Simulation of Magnetic Pulse Welding”. In chapter “Numerical Analysis of Heat Transfer of Arc Welded Plate”, finite difference method has been used to provide solution for moving heat source with Gaussian distribution of heat flux density during submerged arc welding. The micro-friction stir welding of aluminium sheets and the joint strength and hardness characteristics are described in chapter “Development and Analysis of Butt and Lap Welds in Micro-friction Stir Welding (μ FSW)”. Chapter “Numerical Modeling of Impact and Solidification of a Molten Alloy Droplet on a Substrate” discusses the solidification characteristics of an alloy droplet impacting on a substrate using a two dimensional axisymmetric model. Plasma assisted friction stir welding, a hybrid system, is described in chapter “Hybrid Friction Stir Welding of Similar and Dissimilar Materials” with the aim of improving the weld joint quality and joint efficiency. Finally, the basic concepts of roll bonding and accumulative roll bonding as applicable to light weight ductile metals and the influence of various parameters on the joint strength are described in chapter “Solid-State Joining by Roll Bonding and Accumulative Roll Bonding”.

Authors and editors have taken utmost care in presenting the information and acknowledging the original source wherever necessary. Editors are thankful to authors, organizers of AIMTDR and staff of AIMTDR (India) for making the publication of this type of research book possible. Readers are requested to provide their feedbacks and constructive suggestions to us. We hope that manufacturing fraternity will welcome this book.

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