

# Marcel Hermans

Ass. Professor



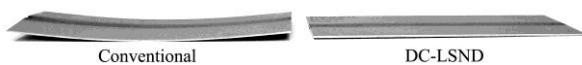
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Research interests:  
Welding and Additive Manufacturing, Welding metallurgy. Stress and distortion evolution and control during welding. Hot cracking.

## Welding and Additive Manufacturing

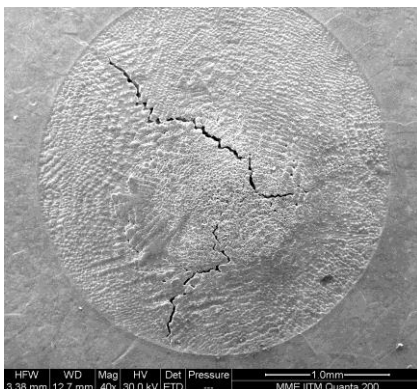
Recent Research activities:

The thermal cycle during welding and other manufacturing techniques destroy the carefully designed microstructure of materials. The evolution of stresses during this cycle may result in distortion of the component. Strategies were studied to mitigate distortion, see Figure 1.



*Fig.1 Comparison of distortion between conventional and Low Stress No Distortion welded plate [van der Aa]*

Stress development in combination with segregation during solidification may result in hot cracking, which is a concern in advanced high strength steels (AHSS) and ultra-high strength steels (UHSS). The high alloying content, required to stabilise the multi-phase microstructure of these steels, makes the material sensitive to hot cracking, see figure 2.



*Fig.2 Hot crack in dual phase steel [G. Agarwal]*

Additive Manufacturing of metals is a research area that is rapidly developing, making it possible to create 3D products based on a layer-by-layer building strategy. The processes used are closely related to welding processes and similar metallurgical aspects are valid. Wire Arc or Wire Laser Additive Manufacturing (WAAM, WLAM) processes enable creating functionally graded materials.

Key publications:

- [1] Dutta, R.K.; Malet, L.; Gao, H.; Hermans, M.J.M.; Godet, S. and Richardson, I.M. 'Formation of Nanostructures in Severely Deformed High-Strength Steel Induced by High-Frequency Ultrasonic Impact Treatment', *Metall. Mater. Trans. A*, 46A(2), 813-830, 2015.
- [2] Dutta, R.K.; Petrov, R.H.; Hermans, M.J.M. and Richardson, I.M. 'Accommodation of Plastic Deformation by Ultrasound-Induced Grain Rotation', *Metall. Mater. Trans. A*, 46A(8), 3414-3422, 2015.
- [3] Amirthalingam, M.; van der Aa, E.M.; Kwakernaak, C.; Hermans, M.J.M. and Richardson, I.M. 'Elemental Segregation During Resistance Spot Welding of Boron Containing Advanced High Strength Steels', *Welding in the World* 59(5), 743-755, 2015.
- [4] Van der Aa, E.M.; Amirthalingam M.; Winter, J.; Hanlon, D.N.; Hermans, M.J.M.; Rijnders, M. and Richardson, I.M. 'Improved Resistance Spot Weldability of 3rd Generation AHSS for Automotive Applications' 11th International Seminar on Numerical Analysis of Weldability, Seggau, Graz, Austria, 27- 30 September 2015. Winner Best Paper Award.

