IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Scanning Path Optimization in Selective Laser Melting of Ti6Al4V for Aerospace Applications**	
Project Number	**IMURA0846**	
Monash Main Supervisor (Name, Email Id, Phone)	Aijun Huang, aijun.huang@monash.edu	*Full name, Email*
Monash Co-supervisor(s) (Name, Email Id, Phone)		
Monash Head of Dept/Centre (Name,Email)	Neil Cameron, neil.cameron@monash.edu	*Full name, email*
Monash Department:	Department of Materials Science and Engineering	
Monash ADGR (Name,Email)	Jane Wilkinson, jane.wilkinson@monash.edu	*Full name, email*
IITB Main Supervisor (Name, Email Id, Phone)	Deepak Marla	*Full name, Email*
IITB Co-supervisor(s) (Name, Email Id, Phone)		*Full name, Email*
IITB Head of Dept (Name, Email, Phone)	Bhalachandra Puranik, head.me@iitb.ac.in	*Full name, email*
IITB Department:	Mechanical Engineering	

Research Clusters:

Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*	
1	*Material Science/Engineering (including Nano, Metallurgy)*
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*
3	*Math, CFD, Modelling, Manufacturing*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*
8	*HSS, Design, Management*

Research Themes:

Highlight which of the Academy's Theme(s) this project will address? *(Feel free to nominate more than one. For more information, see www.iitbmonash.org)*	
1	*Advanced computational engineering, simulation and manufacture*
2	*Infrastructure Engineering*
3	*Clean Energy*
4	*Water*
5	*Nanotechnology*
6	*Biotechnology and Stem Cell Research*
7	*Humanities and social sciences*
8	Design

The research problem

Define the problem

Laser additive manufacturing is a disruptive technology that has the capability to produce 3D components of different geometrical features. Selective laser melting, is an additive manufacturing technique in which metal products are manufactured in a layer-by-layer manner using a powder bed. Despite several advantages, the process suffers from defects such as distortions, residual stresses, localized deformations and warpage primarily caused due to localized heating and high temperature gradients. These issues can be addressed by controlling the process parameters and by optimizing the scanning path trajectory. The aim of the project is to optimize the scanning path trajectory in order to minimize distortions and residual stresses during selective laser melting of Ti6Al4V, which has wide applications in the aerospace industry. The work would involve synergistic approach with computational modeling and experiments to characterize residual stresses, porosity, and microstructural changes.

Project aims

1. *To develop computational tools to optimize scanning path during selective laser melting of Ti6Al4V.*
2. *Perform experiments to characterize residual stresses, microstructural changes, and thermal distortions at different laser parameters.*
3. *To determine the optimal laser scanning path in order to minimize residual stresses and thermal distortions.*

Expected outcomes

1. *Developing computational tools to generate scanning path strategy in selective laser melting process*
2. *Improve the quality of the products manufacturing using selective laser melting with minimal defects.*

How will the project address the Goals of the above Themes?

1. *The research would lead to the development of novel computational techniques for broad applications in additive manufacturing.*
2. *The research would enable the use of selective laser melting for manufacturing of critical components in the aerospace industry.*

Capabilities and Degrees Required

Essential skills:
Strong background in heat transfer, material science, basic physics, mathematical modeling, and computational methods
Computer programing in C/C++, Java or Fortran, Matlab

Additional skills (not mandatory):
Finite Element Methods, Finite Difference Methods

Qualifications:
B.Tech/M.tech in Mechanical Engineering, Materials Science and Engineering, Aerospace Engineering.

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.
1. Prof. Ramesh Singh (Mechanical Engineering, IIT Bombay)
2. Prof. Xinhua Wu (Materials Science and Engineering, Monash University)

Select up to **(4)** keywords from the Academy's approved keyword list **(available at http://www.iitbmonash.org/becoming-a-research-supervisor/)** relating to this project to make it easier for the students to apply.

Computational Fluid Dynamics and Mechanics, Data Science,optimisation,algorithms, Modelling and Simulation