



## Life at IIT Hyderabad & Around Additive Manufacturing

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### About me

This is Somashekara M A. I did my M.Tech (First Batch) and PhD in the year 2011 and 2016 respectively from the Department of Mechanical and Aerospace Engineering at IITH. I went on to do my post-doc at the Singapore University of Technology and Design (SUTD) and Ames laboratory. At the Ames lab, I worked on a project titled "In-Situ Data Analysis and Tool Development for Additive Manufacturing Metal Powder Systems" which is funded by the United States Department of Energy. The project is a collaboration between Stanford Linear Accelerator Center (SLAC), Lawrence Livermore National Laboratory (LLNL), and Ames laboratory.

I am currently working as an assistant professor at the IIT Dharwad. Recently, I received the Technology Translation award (TETRA) from the SERB for 4D Printing technology Development and transfer.

### Life at IITH

It's difficult to word my time of 6 years (MTech+PhD) in 2-3 pages at IITH. My journey at IITH started in August 2009 (first batch M.Tech). We spent our first semester at IIT Madras, where the IITH office was not more than 15 X 15 ft and with only 3-4 staff, 30 M.Tech students, and a few PhD students, and courses were carried out along with IIT Madras. Around the end of December 2009, we all moved to the ODF campus. We faced a lot of challenges in the initial days however, with the help of new and young faculty we progressed together.

It was a learning experience to see the progress of IITH from less than 200 students (all programs) to 2000 students when I left. We had often joked that we are seniors to any faculty member in the department. I learned a lot from Prof. Raja Banerjee, the MTech supervisor. He is a very supportive and kind person.

I enjoyed learning the courses taught by Prof. Suryakumar (Rapid Prototyping and Manufacturing, CNC and Part Programming, Manufacturing core lab), Prof. Vinayak Eswaran (Mathematical Methods for engineers), Prof. Abhay Sharma (Advanced Material joining processes), Prof. N V Reddy (Rapid Prototyping), Prof. Ashok Pandey (Design Core lab). Prof Prashanth and Prof Ramji M helped in several ways during my journey.

It was Prof Surya who inspired me a lot and supported me both personally and academically as well. Prof. Surya's philosophical emails have changed my life in many ways. There were days when I had left hope for myself, but he always had confidence in me which drove me to work hard and go on and on.

My heartfelt thanks to Prof Vinayaka Eswaran, who inspired me a lot in more ways than one during this journey.

I was a PhD representative and Senate Member during 2013-2014 and it was a learning experience during that period related to various fractional course reviews and discussions. I think because of that position leadership qualities improved a lot. I must say thanks to my PhD batchmates who trusted and voted for me. Special thanks to Dr. Hari Prasad C and Mr. Bhagath Singh M.

I just love the ODF campus very much, from day one (December 29, 2009) to October 2015, I was always happy to stay in the campus, Room 508 (Special thanks to Mr. Bhagath Singh M, roommate) which is so special to me, Tuesday and Friday market, eating chats in complex, Amul fast food, Night canteen, Sarath stadium, South gate and so on. I always dreamt of staying on the permanent campus of IITH which was under construction since my MTech. Finally, I happened to stay there for three months (October 2015-Jan 2016) towards the end of my tenure, room no 416 C-Block was also special to me.

Last but most important, I met Ms Manasa K, my wife who supports all my endeavors. There is not a single doc that went out without her review including my PhD thesis and publications.

### Additive Manufacturing Research work at IITH

In August 2011, I joined a PhD program under the guidance of Prof. Suryakumar S. We had developed Twin-wire additive manufacturing (Industrial robot with twin-wire welding setup) for gradient objects fabrication (Wire arc additive manufacturing (WAAM)). I was a part of various events/activities related to additive manufacturing viz, digital symposium conference, NATFOE, departmental events, etc. Definitely, it was a great research experience in the area of additive manufacturing and the reason I am today. I must thank all staff members (Workshop, Manufacturing labs, etc.)

### Additive manufacturing and 3D printing Lab at IIT Dharwad

I joined IIT Dharwad as an Assistant Professor, before that I spent 3 years at SUTD Singapore, Ames Laboratory, Critical Material Institute, and Iowa State University. The experience I gained at IITH, SUTD, and Ames Laboratory helped me establish labs and research facilities at IIT Dharwad.

At IIT Dharwad our research group is working on different problems in the areas of additive manufacturing. Followings are a few areas,



My research group at IIT Dharwad

**1. 3D Printed Mechanical Metamaterials**

The research work is aimed at developing a combination of multi-material and meta-materials via additive manufacturing with a focus on fabricating multi-material components with meta-material features for different applications. Designing innovative structures of metamaterials will lead to the development of advanced materials with special properties. The experimental investigation presented in this work involves the design, simulation, fabrication, and testing of three different mechanical metamaterial models as shown in **Figure 14** i.e. Chiral, Re-entrant, and Hybrid printed in acrylonitrile styrene acrylate (ASA) using fused deposition modeling (FDM). Also, a uniaxial compression test and ex-situ characterization was performed for studying the mechanical properties, the types of fracture, and crack propagation of the printed metamaterial models which may lead to the development of metamaterials with tunable compressive/bending stiffness.

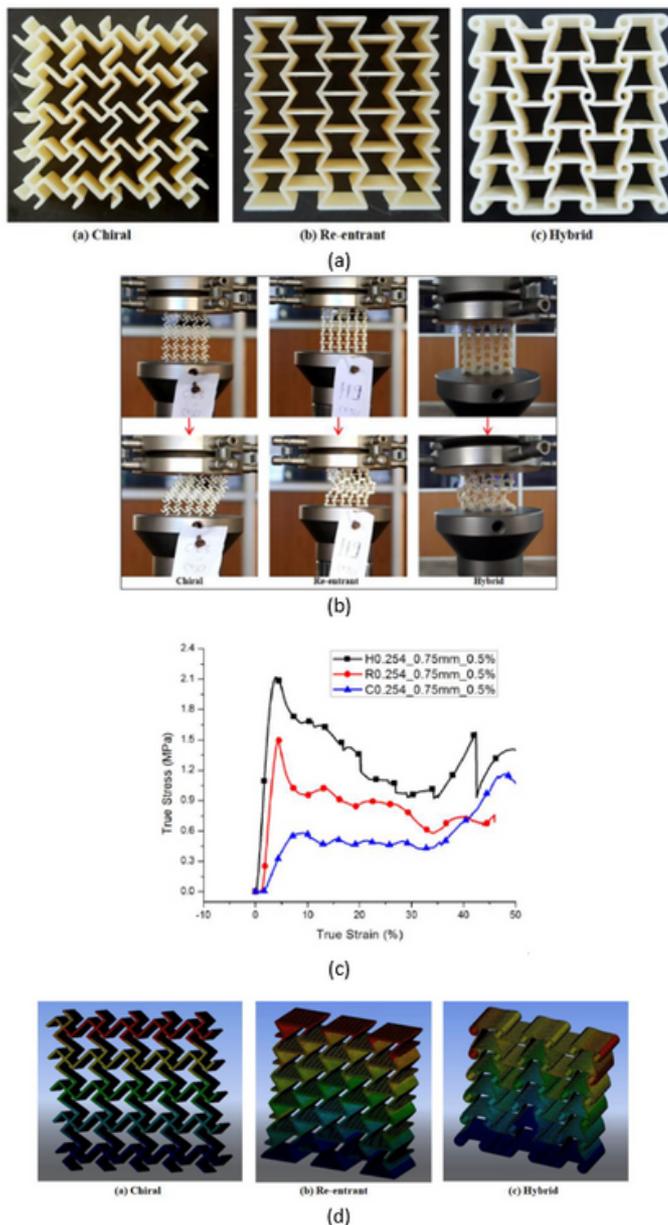


Figure 14. (a) 3 Printed Mechanical Metamaterials, (b) Deformation of printed meta-materials under compression test with 0.5% s<sup>-1</sup> strain rate (b) True stress-strain relationship between uniaxial hybrid, re-entrant, and chiral models, (Sunil M et.al, SFF 2021).

**2. Functionally Gradient Objects Via Hybrid Additive Manufacturing Process.**

This research work collaboration between three institutes IITH (Prof. Suryakumar), NIT Surathkal (Prof. Srikanth), and IIT Dharwad, and the project is funded by SERB. Prof. Surya is leading this project. This research work is aimed at the development of Functionally Gradient Materials (FGM) via the Hybrid Wire-Powder DED process to achieve high feature resolution and deposition rates. Development of integral system capable of sequential and subsequently, simultaneous hybrid Wire-Powder DED process for achieving FGMs

**3. 4D printing Technology.**

This research is aimed at the Design and Development of 4D Printing technology for different applications. Focus is basically the integration of smart materials (shape memory alloys, shape memory polymers) during 3D printing so that printed parts have dynamic structure instead of static structure (typically 3D printed parts are only static). Here we are developing mathematical models, different designs, smart material integration, the behavior of smart material, type of actuation, external stimuli, etc. This work is patented and funded by SERB. Also, received Technology Translation Award 2022.

**4. Self-healing and Gradient structure applications**

India is a land of rich history and cultural heritage. In ancient days, many popular metallic structures were developed. One such structure is Delhi Iron Pillar erected about 1600 years ago. The pillar is made up of Wrought Iron. The pillar is referred to as a “Rust-less pillar” since it did not rust to date. There is a material variation from inside to outside in the form of the gradient. Research takes into account, the ancient manufacturing ideas and gives it a modern touch to suit present requirements. The present proposal aims at the development of engineering structures, gradient structures, self-healing objects via polymer (Material Extrusion), and metallic (Wire-Directed Energy Deposition) additive Manufacturing processes. This research work is funded by the Indian Knowledge System (IKS).

**Acknowledgment:**

I take this opportunity to acknowledge everyone (Family, Friends, Staff members, faculty members, etc.) who was a part of my journey at IITH starting from August 2009-Jan 2016. As a concluding remark, I would like to say that IITH is one of the premier institutes and growing faster and faster with the best research facilities, best faculty members, and fostering an excellent innovation environment If you want to reach me, please mail me at [somashekara@iitdh.ac.in](mailto:somashekara@iitdh.ac.in) or [somashekara.ma@gmail.com](mailto:somashekara.ma@gmail.com)



This photo was taken soon after my Ph.D viva voce