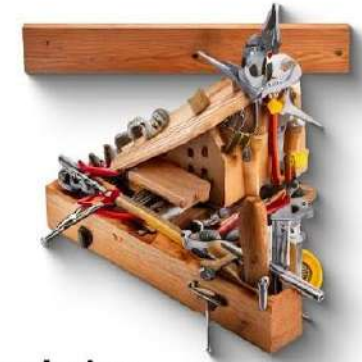




# Welcome to Session By Technical Education and Skilling on Empowering Bengal: Nurturing Future Ready Skills For A High Precision Work Force

**BENGAL GLOBAL  
BUSINESS SUMMIT**

5-6 February '25



**Shrinivas Bhat K.R**

**Technical Director and Co-Founder**

**Entuple Technologies Pvt.Ltd – A 15 year old company with 120 plus people providing Simulation Engineering services to the Space and Defence sectors .**

With 35 plus years experience in Engineering Simulation, Telecom, Networking and RF domains Shrinivas is handling a team of 30 plus Engineers working on simulation of complex projects in Aerospace and Defense across various physics – High Frequency (RF), Low Frequency ( Motors and Transformers), Mechanical ( Thermal, Fatigue, Impact and Crash Analysis) and Fluids( Fluid Structure Interface, Supersonic flows etc).

Shrinivas has a Bachelors in Electronics Engineering from R.V College Of Engineering, Bangalore University.

**Shrinivas Bhat K.R**



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**BENGAL means BUSINESS**



*Precision Engineering-Technology  
Used In Space and Defence*

*Shrinivas Bhat  
Technical Director  
Entuple Technologies*

# Space and Defence Equipments

- Typical Space products are Satellites, Ground Stations with large antennas ,Solid Fuel Rockets, Liquid Fuel Rockets, Launch Pads etc.
- Typical Defence equipment comprises of Aircraft, Tanks and Battleships with complex electronic gear and precision mechanical and optical components.
- Precision engineering is a field dedicated to creating high-accuracy components and systems. As technology advances, the tools and techniques used in this field continuously evolve to meet increasing precision demands.

## Innovations in Precision Engineering

- **Miniaturization, Automation , Sustainable Practices like 3D printing: Advanced Materials.**

## Tools Used in Precision Engineering

- **CNC Machines, Coordinate Measuring Machines (CMM), Laser Cutting Tools, Optical Microscopes.**

## Techniques for Optimal Performance

- **Computer-Aided Design (CAD),Finite Element Analysis (FEA),Surface Finishing,Quality Control Processes.**

## Quest for Accuracy

By virtually modeling intricate components and systems, engineers can analyze real-world scenarios without resorting to costly physical prototypes. This allows for an in-depth understanding of how different design variations affect structural performance.

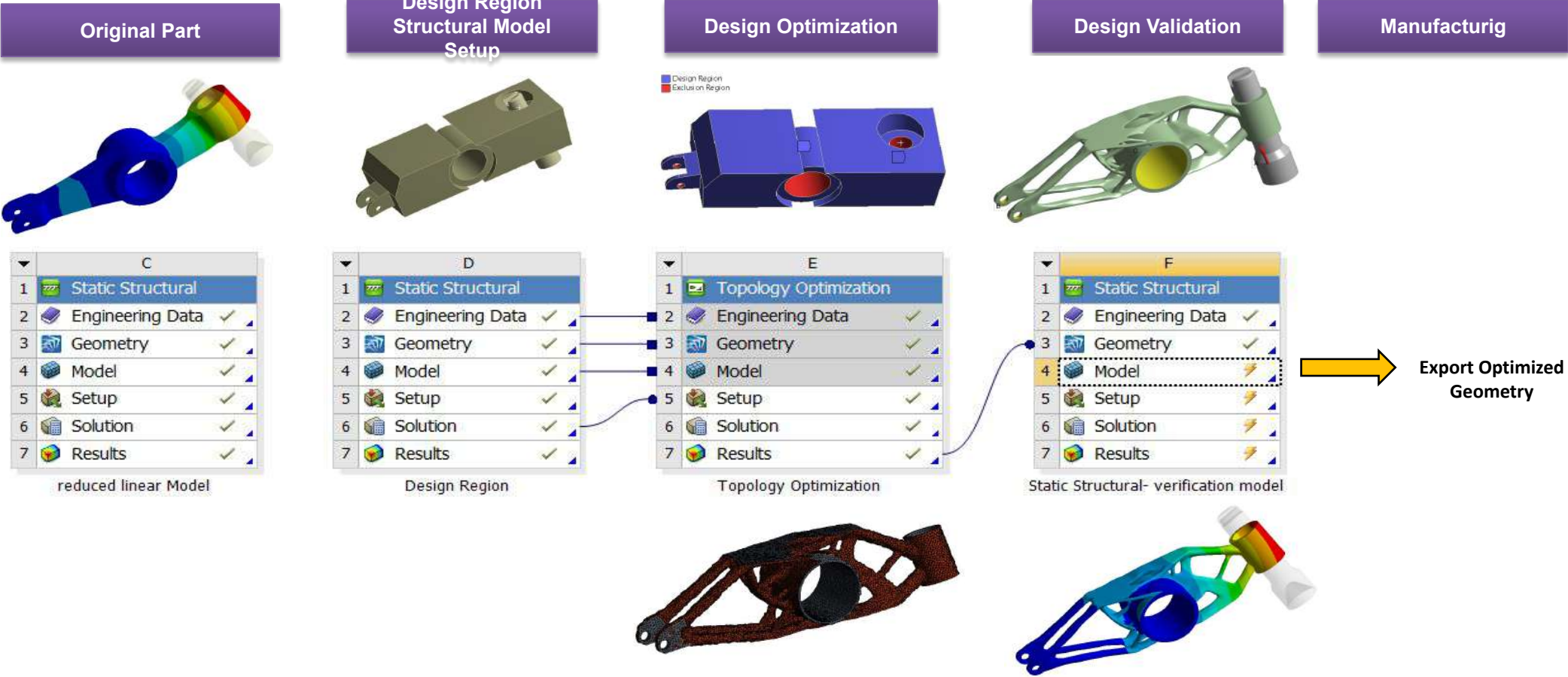
## Structural Integrity: Where FEA Comes into Play

- Ensuring the structural integrity of any design is paramount. Whether it's a towering skyscraper, a cutting-edge aerospace component, or a life-saving medical device, FEA plays a pivotal role in scrutinizing every element's behavior under various conditions. By subjecting a virtual prototype to stress and strain analysis, engineers can pinpoint potential weak points, areas of excessive deformation, or material failures.

## Example:

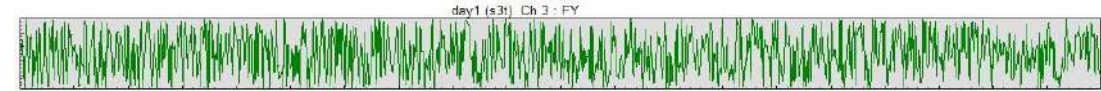
- **Aerospace and Aviation:** FEA is extensively used to analyze aircraft structures, ensuring they can withstand different loads, pressures, and vibrations. It helps optimize lightweight designs while maintaining structural integrity, enhancing fuel efficiency and safety.

# Topology Optimization using Software

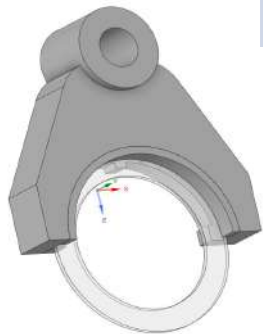


# Gear Selector Fork optimization

- Gearbox selector fork optimization
  - Material: Cast A380 Aluminium Alloy
  - Volume constraint: 85% Reduction
  - Validation of initial and optimised geometry show very similar stiffness
  - Under defined stress state, part would last in excess of  $6.114E+4$  cycles
  - Topology optimization is a viable tool to optimise a selector fork



Load history for 1 day

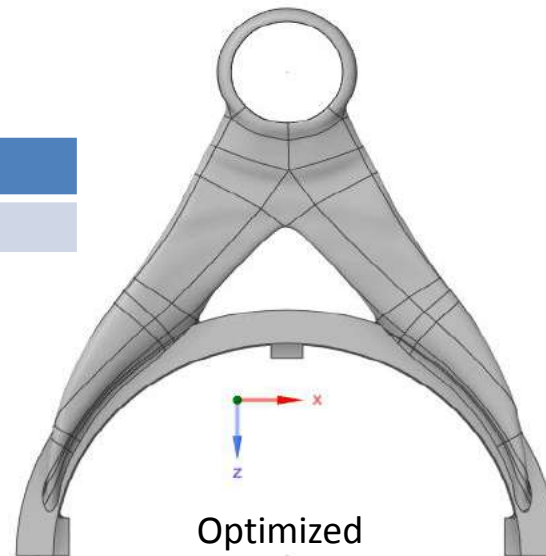


Original

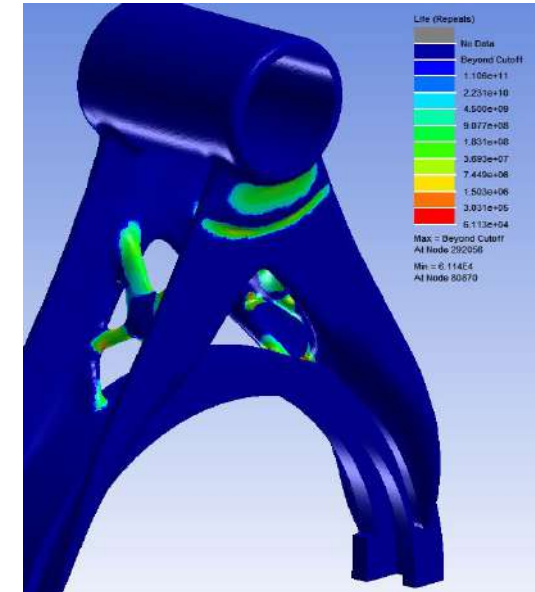
Selector Fork	Original	New
Mass [g]	491	78.6



84% Mass Saving Achieved

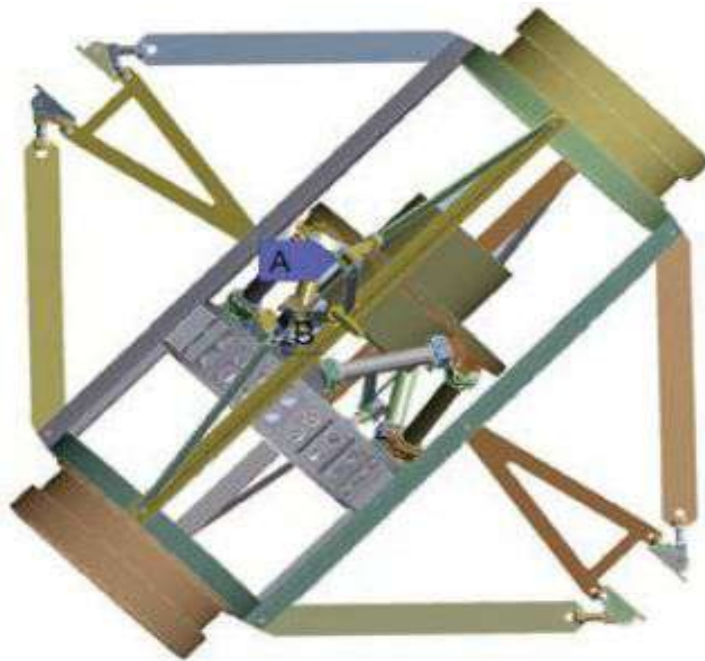


Optimized



## Case Study : Precision Camera Design

- Study the expansion of the universe, and significance of dark energy extremely precise measurements are required
- Dark Energy Survey Project aimed at determining history of the expansion rate of universe
- Capturing photos of 300 million galaxies and measuring shape and red shift (Change in frequency of light and other electromagnetic radiations)
- With such measurements, Scientists will be able to investigate the expansion of universe over  $2/3^{\text{rd}}$  of its total lifetime (a few billion years old)

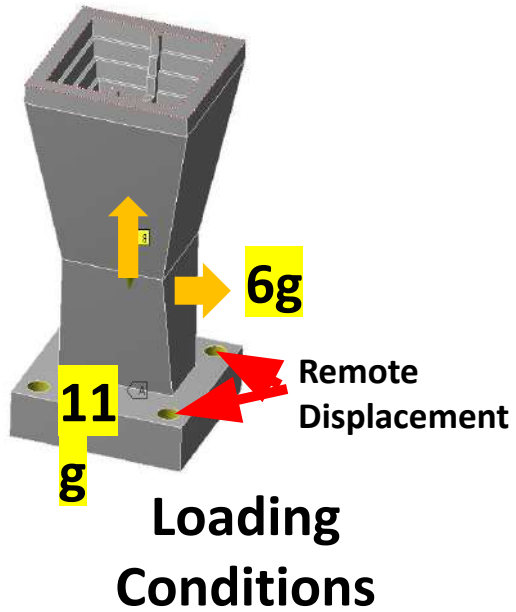


Detailed model of the primary focus cage



Simplified model of the telescope and camera structure

# Horn Antenna Topology Optimization



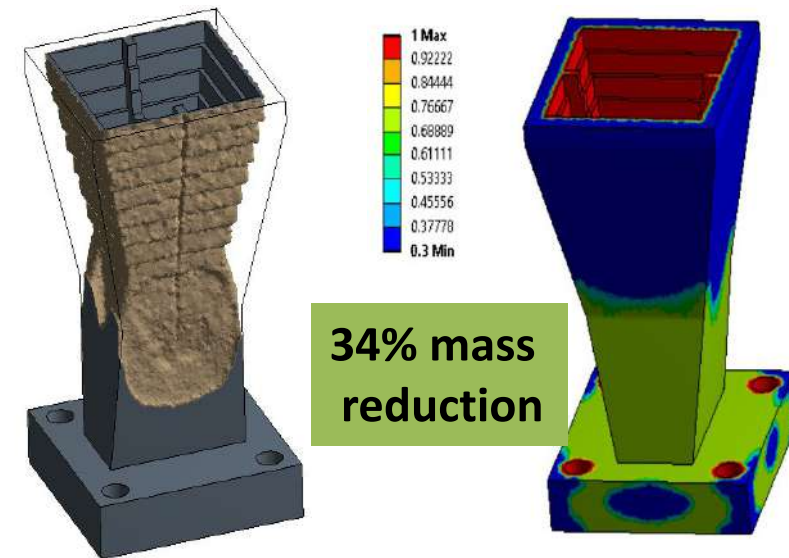
TO allows multiple inertial load scenarios – critical for space application.

## Objectives

Enabled	Response Type	Goal	Formulation	Environment Name	Weight
<input checked="" type="checkbox"/>	Frequency	Maximize	N/A	Modal	1
<input checked="" type="checkbox"/>	Compliance	Minimize	Program Controlled	Static Structural 2	0.5
<input checked="" type="checkbox"/>	Compliance	Minimize	Program Controlled	Static Structural	0.5

## Constraints

- Member size > 1.5 mm
- Global stress < 10 Mpa
- Mass Reduction  $\leq$



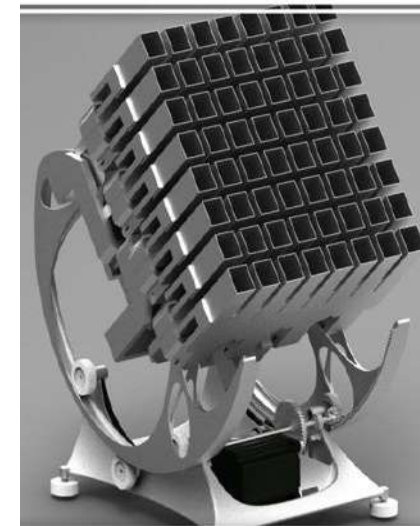
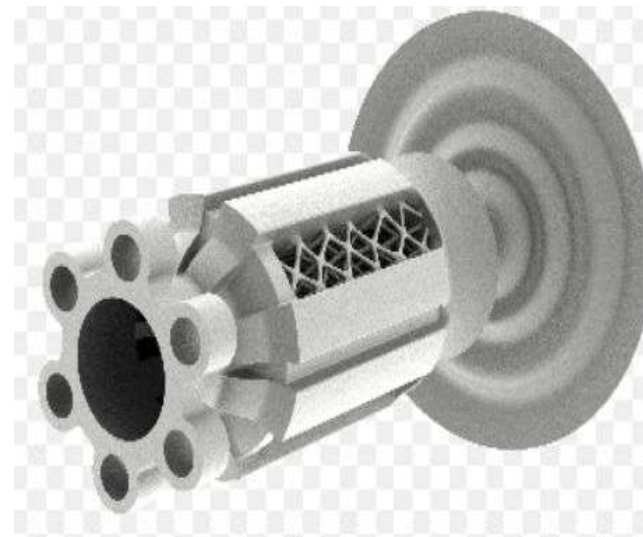
Density based TO

Lattice TO



**Satellites Components and Wave Guides**

**Additive Manufacturing applications in Antenna ,Waveguides**



**X-band SATCOM array**

# Conclusion

- Central to FEA is the specialized engineering software that facilitates the numerical simulations. These software packages provide intuitive interfaces for creating intricate FEA models, defining boundary conditions, and analyzing results
- India needs a big pool of FEA engineers not only in Space and Defence sectors but also in other areas like Automobile , Process Industry ,Bio Medical etc.

**Thank You**