CADFEM

Ansys / ELITE CHANNEL PARTNER

STRUCTURAL ANALYSIS OF DRONE USING ANSYS MECHANICAL

SAE - AeroTHON 2025

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Application Engineer – Structures, CADFEM

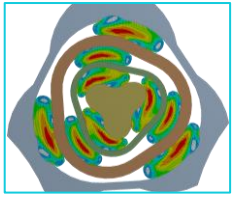
Agenda

- Introduction to Simulation and Virtual Development
- Drone System Overview
- Introduction to FEM, Various Elements
- Workflow in Simulation
- Types of Structural Analysis
- Demonstration
  - **Static Structural Analysis of Hexacopter**
  - **Modal Analysis of Hexacopter**
- Best Practices for FEA

Structures Product Collection

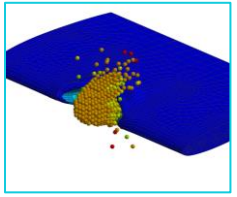
Ansys structural analysis software enables you to solve complex structural engineering problems and make better, faster design decisions. With the finite element analysis (FEA) solvers available in the suite, you can customize and automate solutions for your structural mechanics problems and parameterize them to analyze multiple design scenarios.

Mechanical



Provides in-depth analysis of structural and coupled-field behaviors for broad structural analysis needs through a suite of finite element analysis (FEA) solutions.

LS-DYNA



Integrates into Ansys Mechanical for powerful explicit simulations. A large array of capabilities and material models enable complex models with great scalability.

System Overview

Curtesy: iStock Images

Engineering Challenges of Drones Design

Functional Safety and Software

Engineering Challenges:

- DO-178C Compliance
- Embedded Code Generation and Validation
- Failure Node Analysis
- Traceability
- ARP-4754

Body

Engineering Challenges:

- Structure
- Composites
- Aerodynamics
- Noise

Electronics Reliability

Engineering Challenges:

- Electrostatic Discharge
- EMI/EMC
- Power Integrity
- Shock and Vibration
- Signal Integrity
- Thermal Management
- Warping
- Battery Design

Sensors

Engineering Challenges:

- Accurate Sensor Models for use in Virtual Drone Models
- Sensor Performance
- Sensore Placement

Semiconductors

Engineering Challenges:

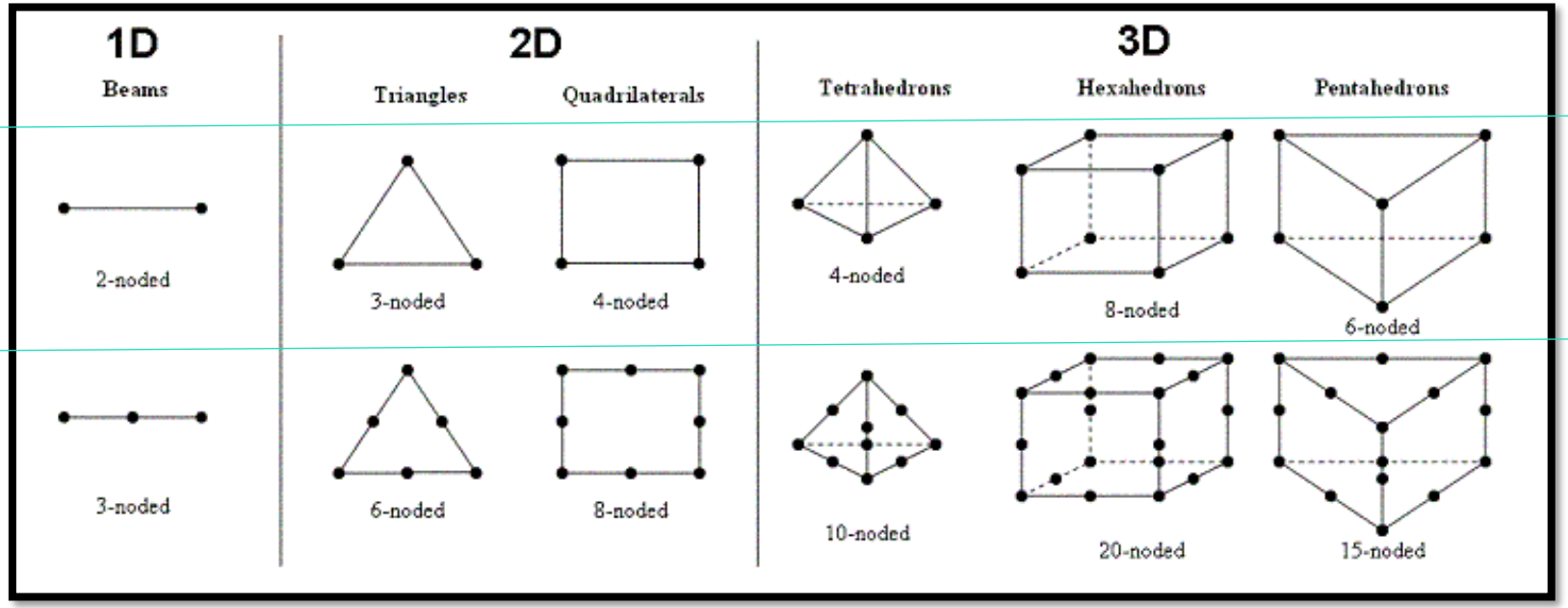
- Complexity
- Power Integrity
- Thermal Management
- Energy Efficiency

Figure 2. Main incremental engineering challenges of drone design on top of fundamental design criteria, such as aerodynamics and aerostructures

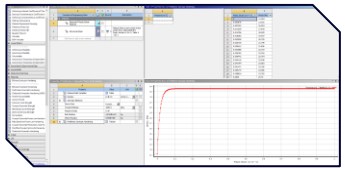
Element types

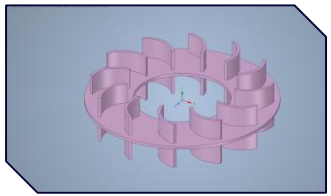
Based on geometrical representation

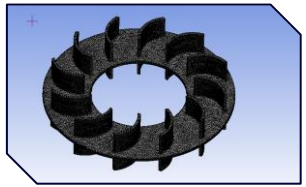
Based on Element Order

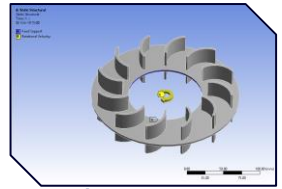


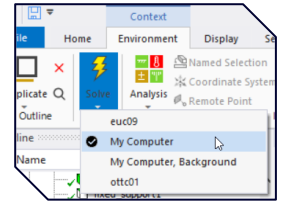
Logical analysis routine

1. 
Material Definition

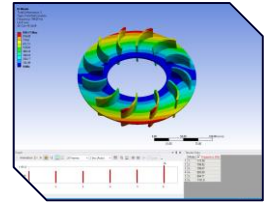
2. 
Geometry Preparation

3. 
Robust Meshing

4. 
Simulation Setup

5. 

Simulation Execution

6. 
Result Exploration

7.

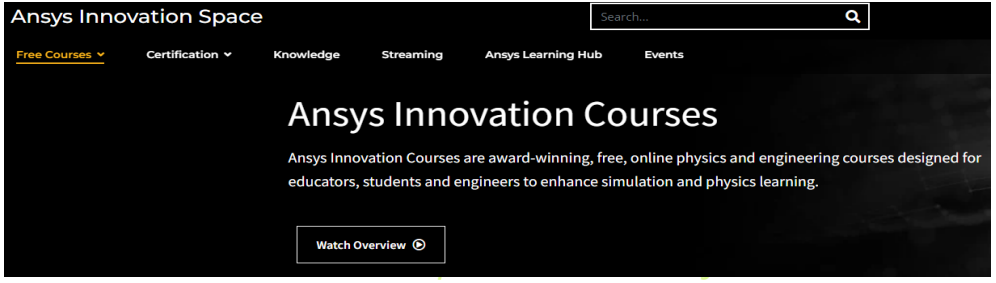
P7 - Geometry Mass	P8 - Stress - Bracket Maximum Maximum Value Over Time	P9 - Strain - Rubber Maximum Maximum Value Over Time	Maxi
kg	MPa	mm mm^-1	
0.98308	282.15	0.053466	1.76
0.98308	256.11	0.043474	1.52
0.98308	299.49	0.063719	1.95
1.0495	243.45	0.042058	1.38
84	184.88	0.028409	0.87

Result Comparison, Reporting

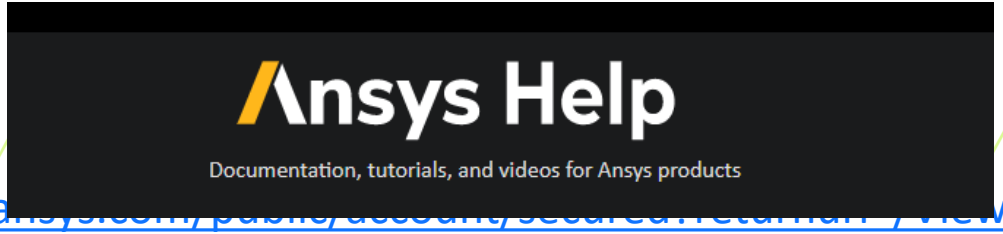
One environment

Ansys Knowledge Resource

Ansys Innovation Courses: [Ansys Innovation Courses | Free, Online Physics Courses]



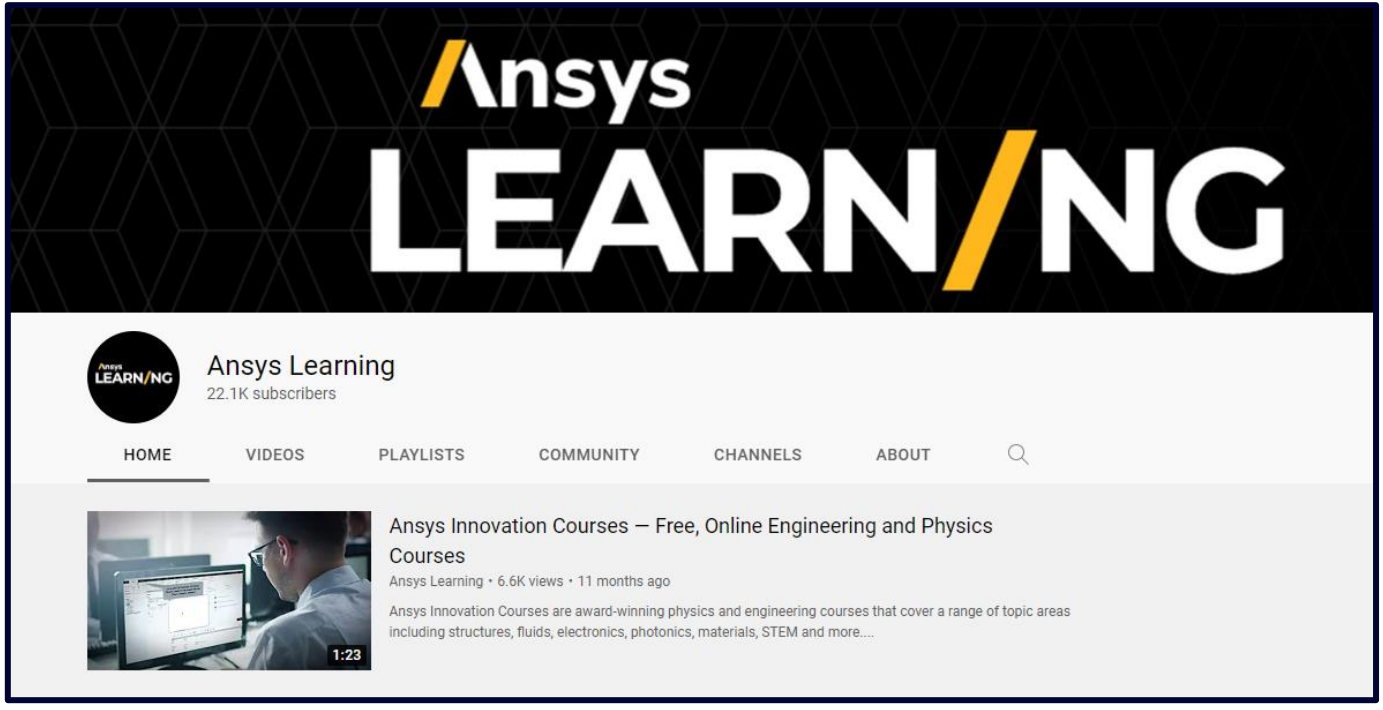
Ansys help: [Mechanical User's Guide (ansys.com)]



https://ansyshelp.ansys.com/public/account/secured?returnurl=/Views/Secured/main_page.html

Ansys Resource For Knowledge

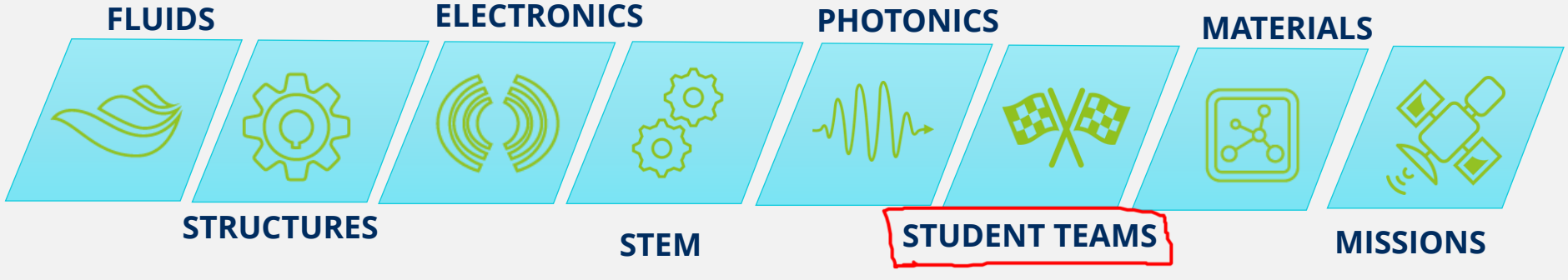
Ansys Learning YouTube Page: [(1046) Ansys Learning – YouTube]



Ansys Innovation Courses (AIC)

230+ award-winning, free, online physics and engineering courses designed for educators, students and engineers to enhance simulation and physics learning.

Courses categories include:



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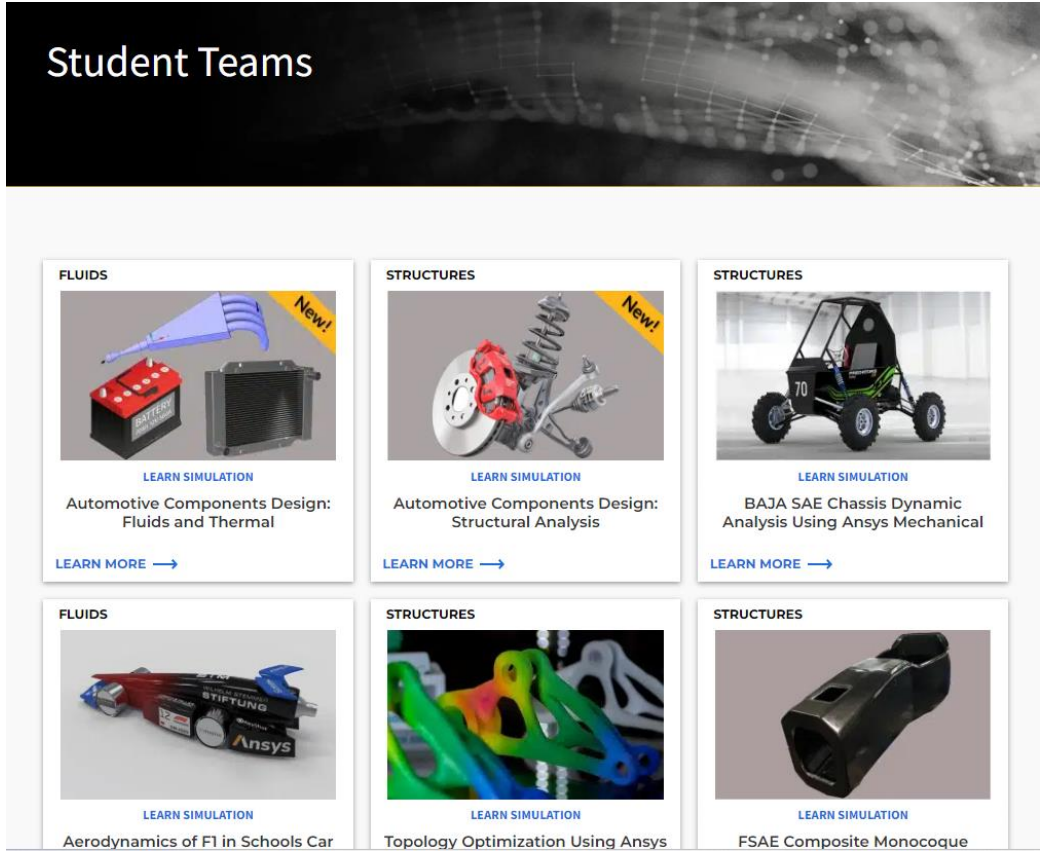
Ansys Innovation Courses (AIC) – Student Team

- ANSYS Innovation Courses are taught by industry experts who have extensive experience in engineering design, analysis, and optimization.
- These instructors can provide valuable insights and guidance to students as they work on their competition projects.

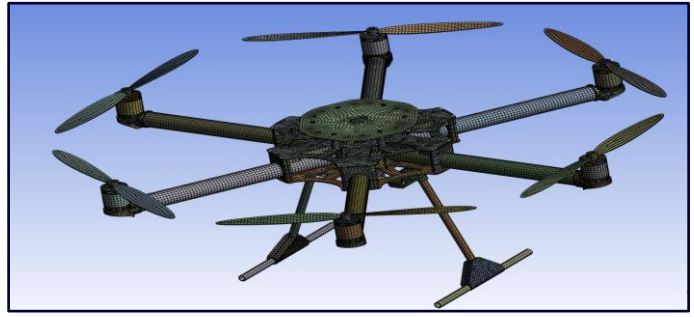


Demonstration

Static Structural Analysis of Hexacopter

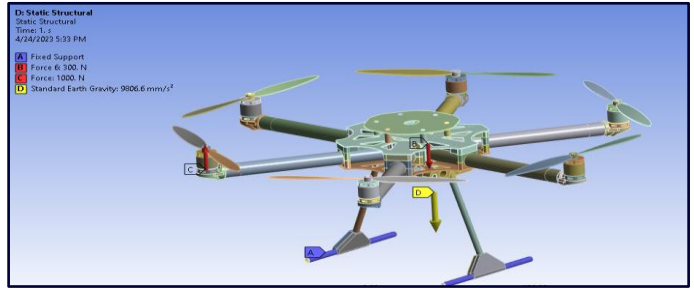
- Material: Aluminum
  - Hexacopter mass = 2.55 Kg
  - Payload mass = 12 Kg
- Contacts: Linear Contacts
- Mesh: Body Sizing – 4 mm

Pre-Processing



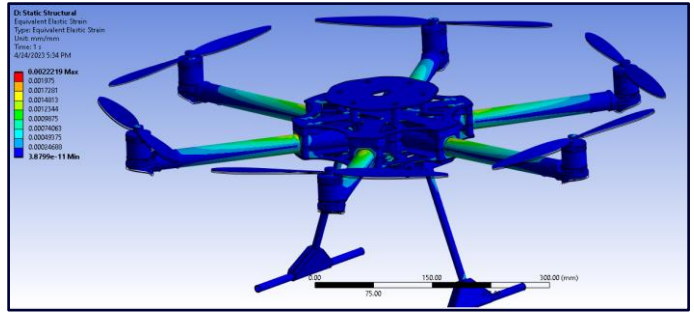
- Loads and Boundary Conditions
  - Thrust force = 60 N each motor
  - Payload force = 118 N
  - Fixed support: Resting faces on ground

Processing



- Results and Discussion
  - Stress, Strain and Deformation

Post-Processing

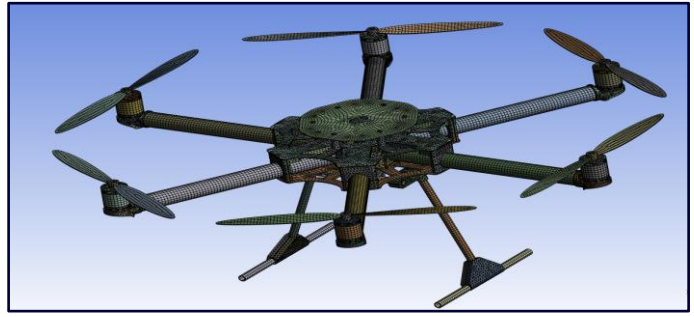


Demonstration

Modal Analysis of Hexacopter

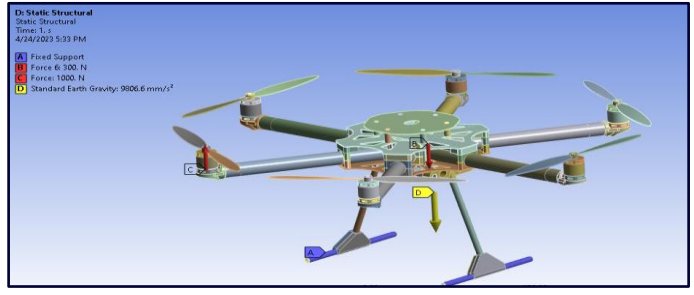
- Material: Aluminum
  - Hexacopter mass = 2.55 Kg
  - Payload mass = 12 Kg
- Contacts: Linear Contacts
- Mesh: Body Sizing – 4 mm

Pre-Processing



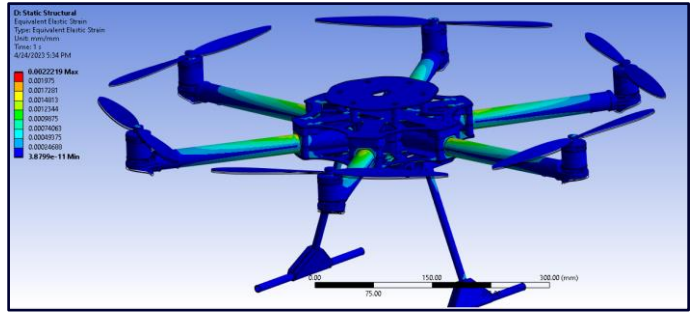
- Loads and Boundary Conditions
  - No structural Loads
  - Fixed Support

Processing



- Results and Discussion
  - Natural Frequency
  - Mode Shapes
  - Mode Participation Factor

Post-Processing



Best Practices for FEA

- Mesh Convergence
- Mesh Quality
- Submodeling
- Types of Analysis
- Material modeling
- Contact Tool
- Averaged and Unaveraged Results
- Adaptive Convergence
- Parametric Study

CADFEM

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