



**FAMU-FSU**  
College of Engineering

# Inlet Guide Vane Monitoring System

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Senior Design  
Team 4

## PROJECT BACKGROUND

Danfoss Turbocor's TT series compressors use Inlet Guide Vanes (IGVs) at the inlet of the compressor to regulate refrigerant mass flow rate and flow direction.

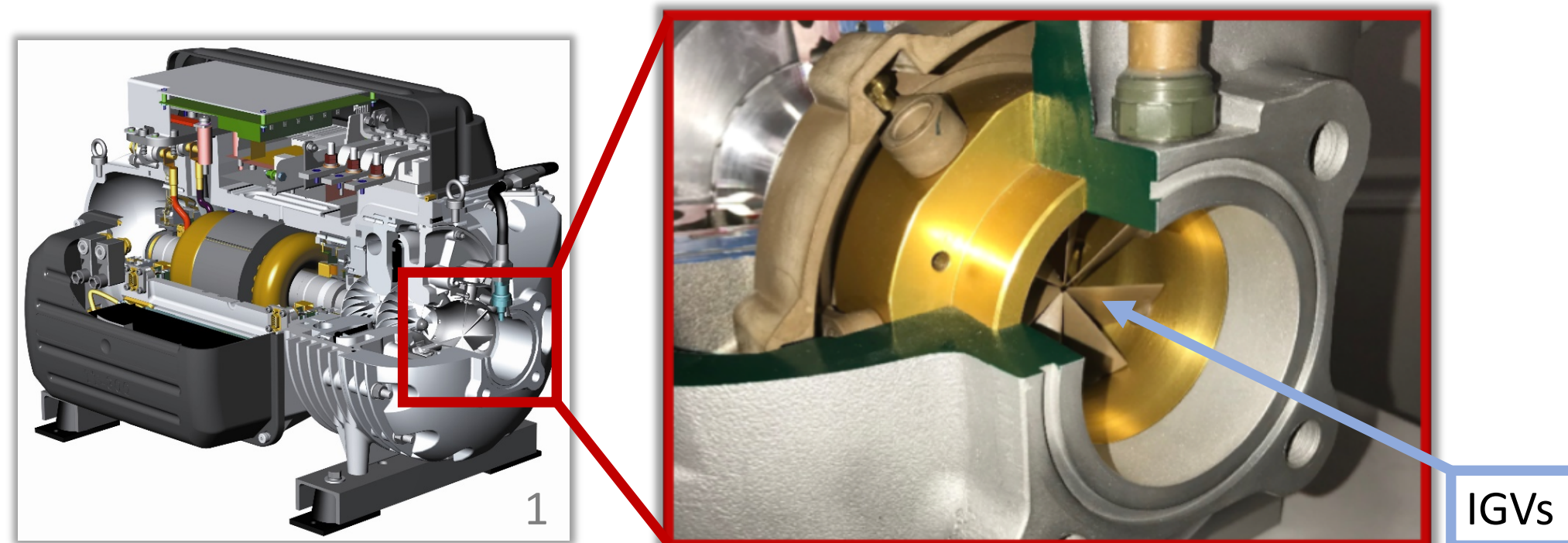


Figure 1: Position of the IGVs on the Danfoss compressor

The IGVs are prone to breaking or failing in the following ways:

- Breaking due to Flow Pressure
- Latching due to Geometrical Interference
- Breaking due to Vane Vibrations

We are tasked with building a monitoring device that can be used by the Danfoss testing department to monitor the integrity of the vanes.

## SELECTED SUBSYSTEM DESIGNS

- Lighting Subsystem**  
Individual LEDs inside the pipe providing light from multiple angles
- Low Cycle Monitoring Subsystem**  
Fiber optic camera or endoscope in central body directed toward the inlet
- Angle Monitoring Subsystem**  
April tags placed on each one of the IGVs whose angle can be measured
- High Cycle Monitoring Subsystem**  
Laser Vibrometer measuring vane amplitude and frequency

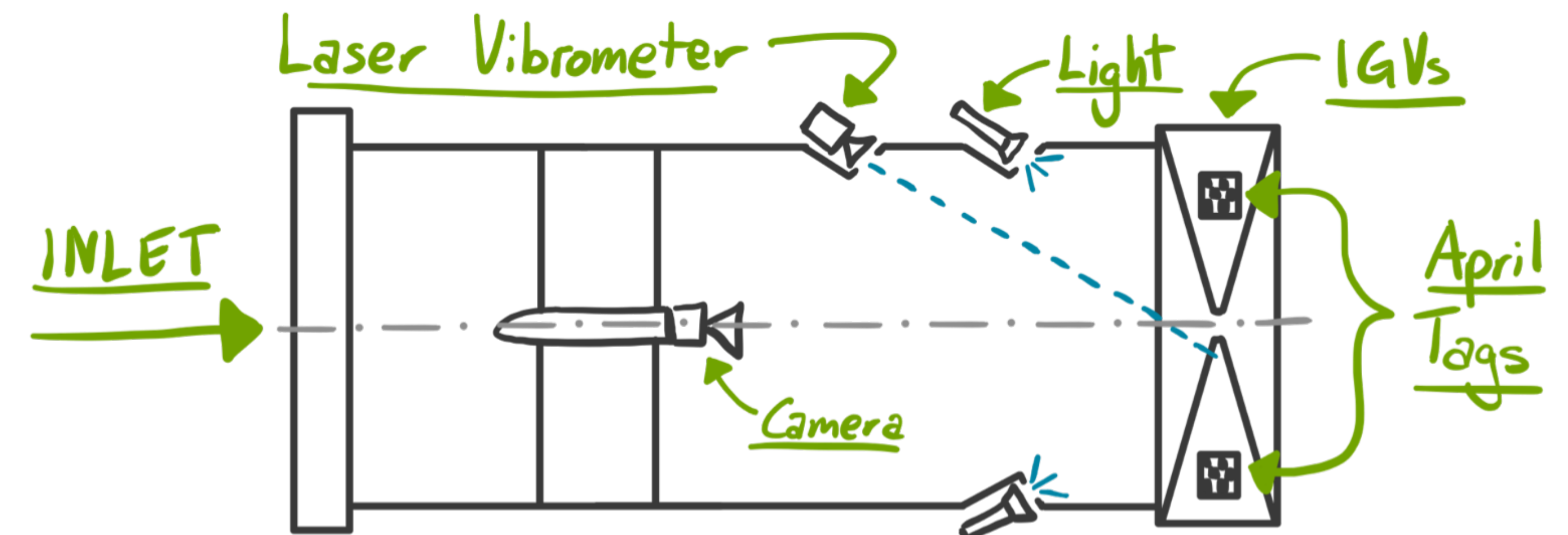


Figure 2: Drawing of the Selected Design



Figure 3: Sample Endoscope, Laser Vibrometer and April Tags

## PROJECT OBJECTIVES

In order to meet the customer needs, the project must accomplish the following objectives:

- Display a live feed of the compressor inlet which can be used to determine if all of the IGVs are present and functioning or if some of the vanes are stuck and not moving
- Develop a lighting system that evenly illuminates the compressor inlet so that the camera can clearly see every IGV
- Provide angle measurements of each individual IGV to determine if one of the IGVs is stuck and not moving
- Monitor for vibrations on the tip of the IGV to determine if there is failure due to high cycle fatigue

## PROJECT TARGETS

The targets and metrics outlined in the table below indicate the minimum performance requirements to successfully fulfill the needs of the customer.

Min. Sampling Rate for Low Cycle Failure	1 Hz
Min. Sampling Rate for Angle Measurement	1 Hz
Min. Angle Measurement Accuracy	10 %
Min. Sampling Rate for High Cycle Failure	1 kHz
Allowable Flow Impact	No Induced Swirl
Max. Pressure Drop Across System	0.02 psi

## SPRING PLAN

- Design** all subsystems and purchase all need parts
- Build** the central body housing, support vanes and sight glasses
- Test** ingress protection, pressure drop, induced swirl, & reading accuracies

## ACKNOWLEDGEMENTS

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\*References available upon request