# M.Tech Project : Canned Motor Pump

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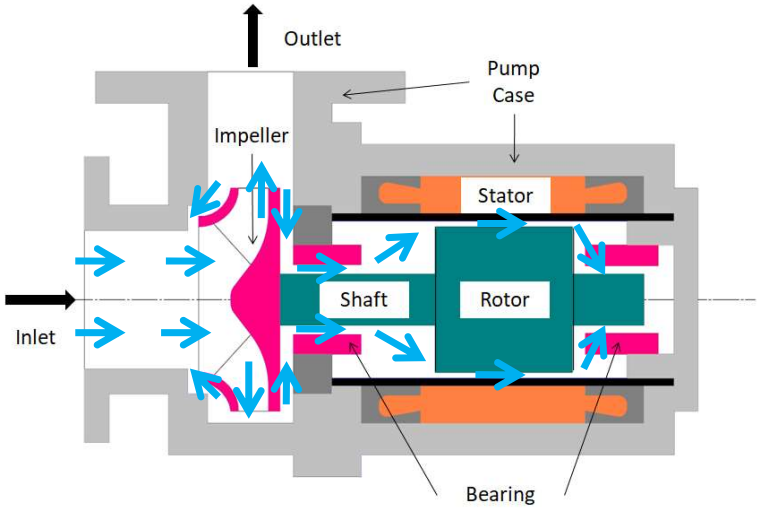
- Objective :
  1. Understanding the fluid flow and heat transfer in rotor cavity
  2. Designing rotor cavity for optimized heat transfer
  3. Design optimized pump casing for noise reduction

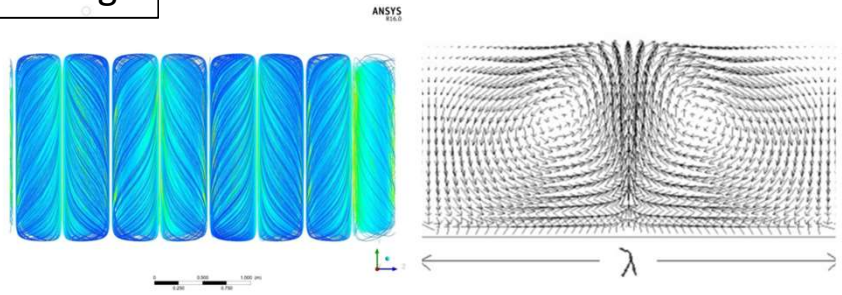
- Process and Methodology :
  1. Literature survey
  2. CFD simulation of flow through cavity
  3. Design of volute and impeller blades
  4. Validation of acoustic response

- Results and Outcome:
  1. Designed and validated pump performance
  2. Validated results with literature and measurements
  3. Harmonics for due to fluid structure interaction are identified

Impeller Design



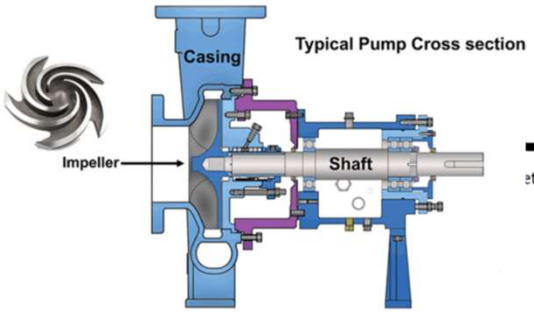

Canned Motor Pump



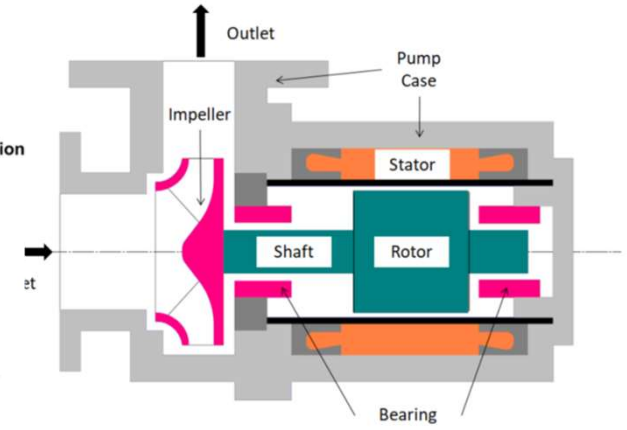

Flow through cavity

# Introduction and Literature Survey






Regular Pump




Canned Motor Pump

Radial Gap

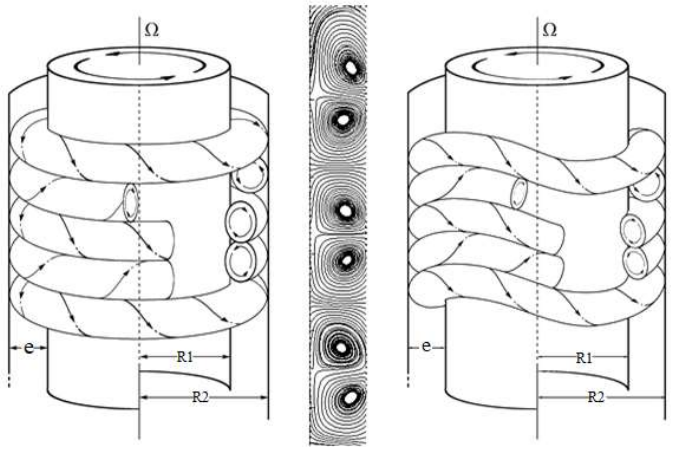
$$e = R_2 - R_1$$

Radius Ratio

$$\eta = \frac{R_1}{R_2}$$

Taylor Number

$$Ta = \frac{\Omega^2 R_1 (R_2 - R_1)^3}{\nu^2}$$



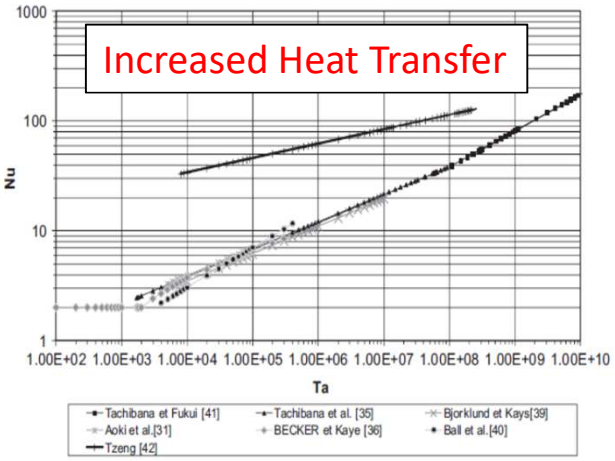

Schematic of Taylor-Couette flow Ref. Fénot et al.

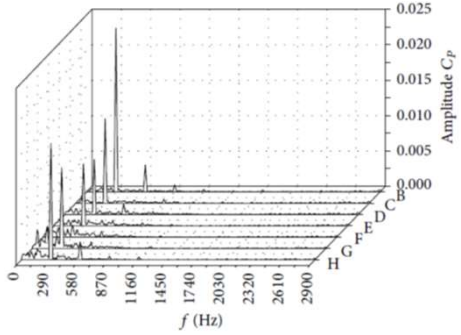
**Advantages :**

- Mechanical seal is not required
- Leak-free configuration
- Less noise compared to conventional pump

**Limitations :**

- Loss in magnetic induction
- Increased heat generation
- Hydrodynamic noise is still present

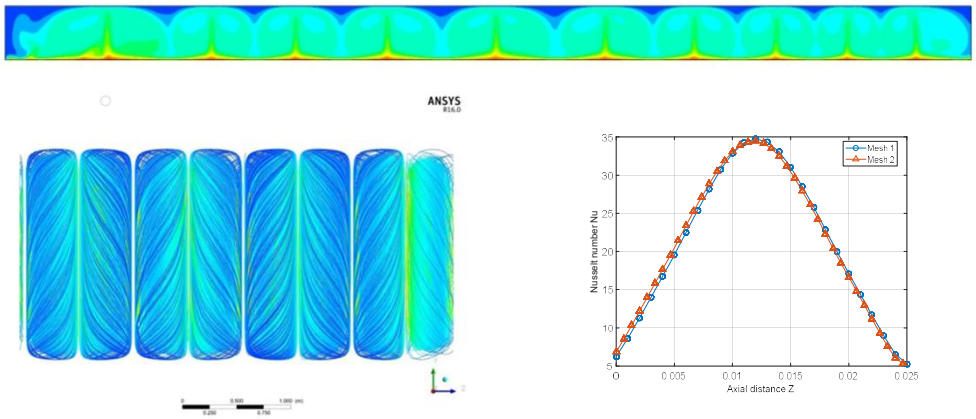



Dominant Noise Frequency due to Unsteady Fluid Structure Interactions

# Flow and Heat Transfer Simulations in Rotor gap

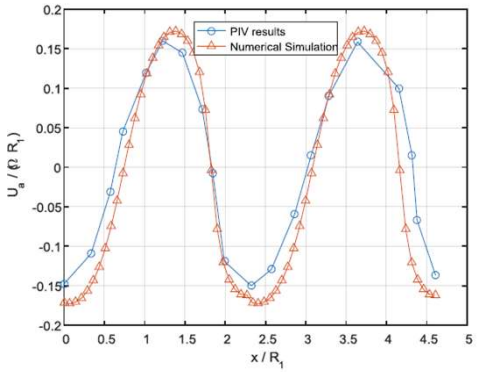




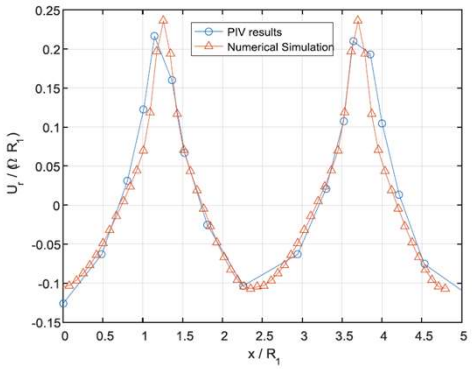

Fully Developed Flow Simulation




Grid Independence Study

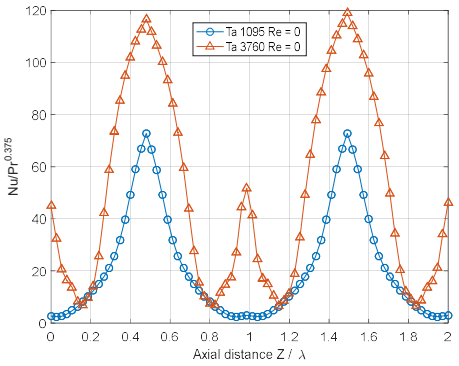



Velocity results compared with Experiment Ref. Abebayo

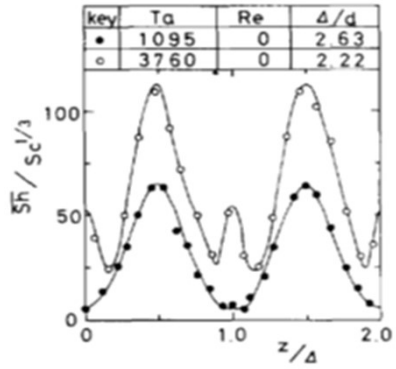



Velocity results compared with Experiment Ref. Abebayo

| Transport Equation | Discretization Scheme |
|---|---|
| Pressure Velocity Coupling | SIMPLE |
| Spacial Discretization | Second Order UPWIND |
| Turbulent Kinetic Energy | First Order UPWIND |
| Turbulent Vorticity | First Order UPWIND |
| Turbulence Model | K-W-SST |




Heat Transfer Variation Simulation




Heat Transfer Variation Experiment Results Ref. Kataoka

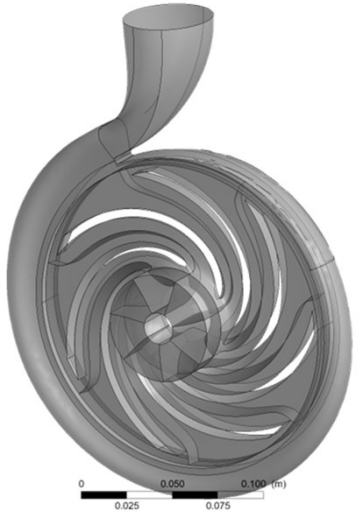
# Design and Flow Simulation for Impeller and Volute



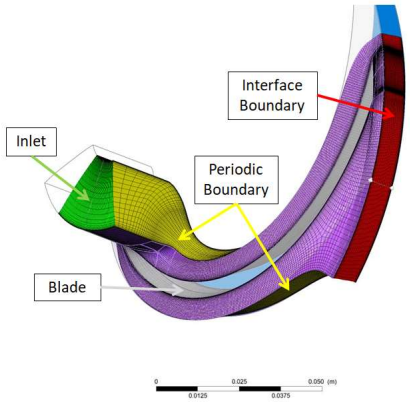
| Design Specifications | Value | Design Specifications | Value |
|---|---|---|---|
| Motor rating (kW) | 60 | Flow rate | 150 |
| Head (m) | 80 | Overall Efficiency % | 55 |
| Rotation speed (rpm) | 2900 | Impeller Dia. (mm) | 255 |

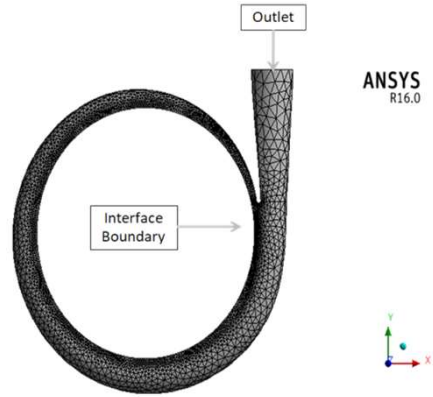
Hydrodyne Pump Design Requirement

Developed MATLAB Code

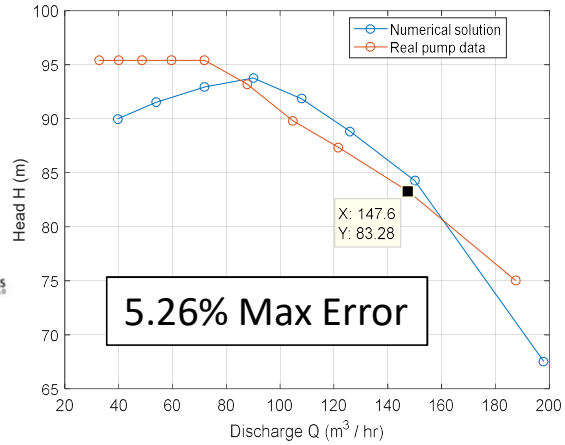


Generated with our code in SOLIDWORKS



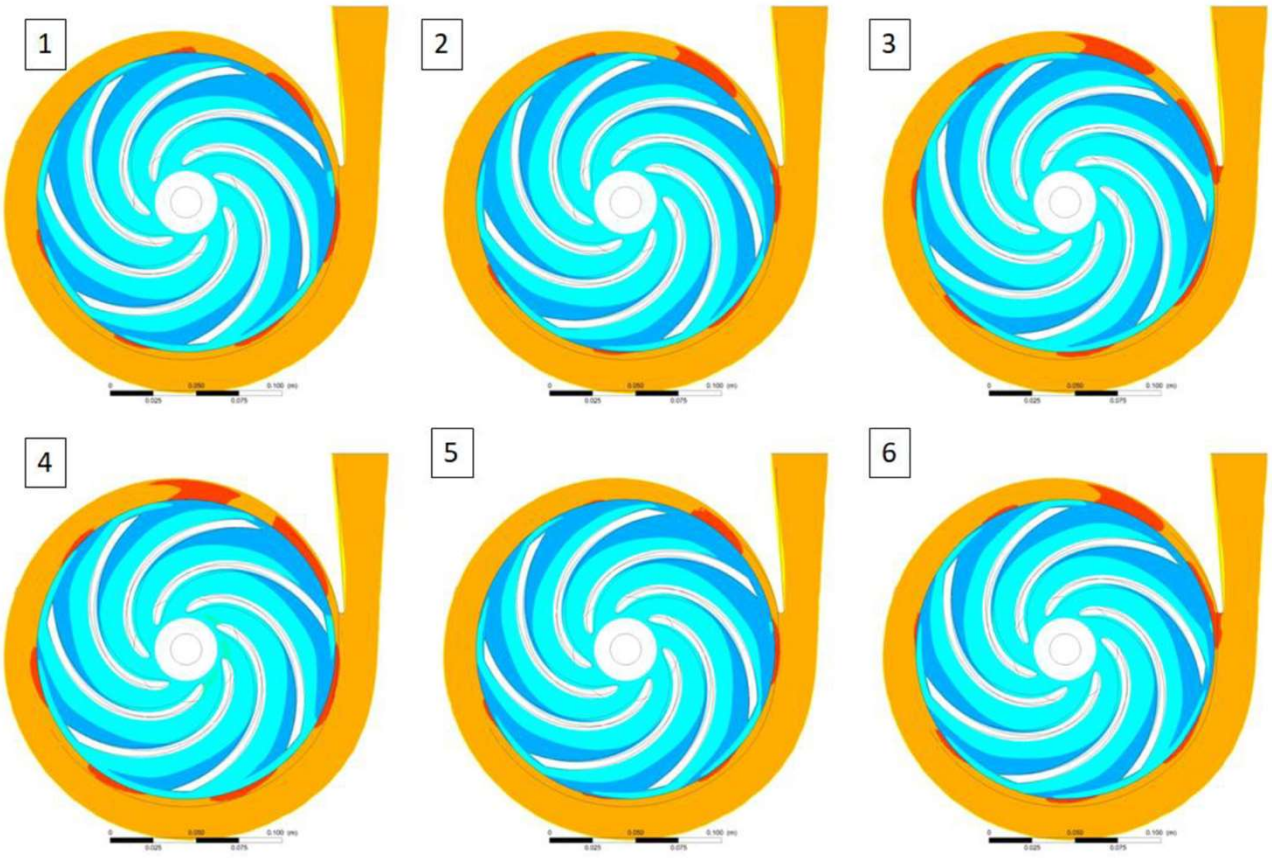

| Type of Mesh | Hexahedral |
|---|---|
| Number of elements | 1844750 |
| Y+ | 1.0655 |



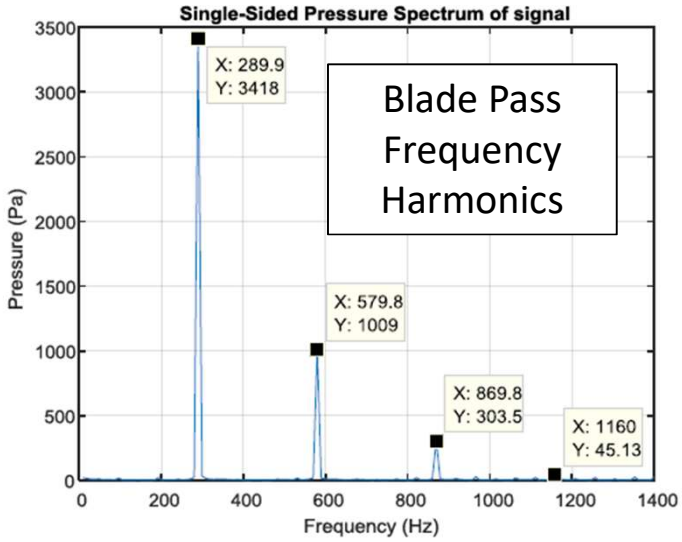

Steady Flow Simulation Results compared with Experiment

# Acoustic Simulation for Unsteady Volute Noise

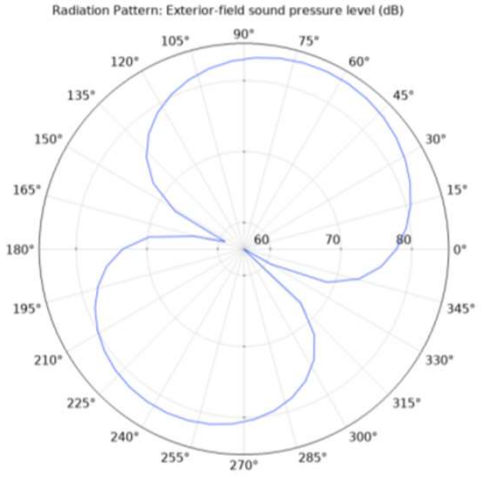




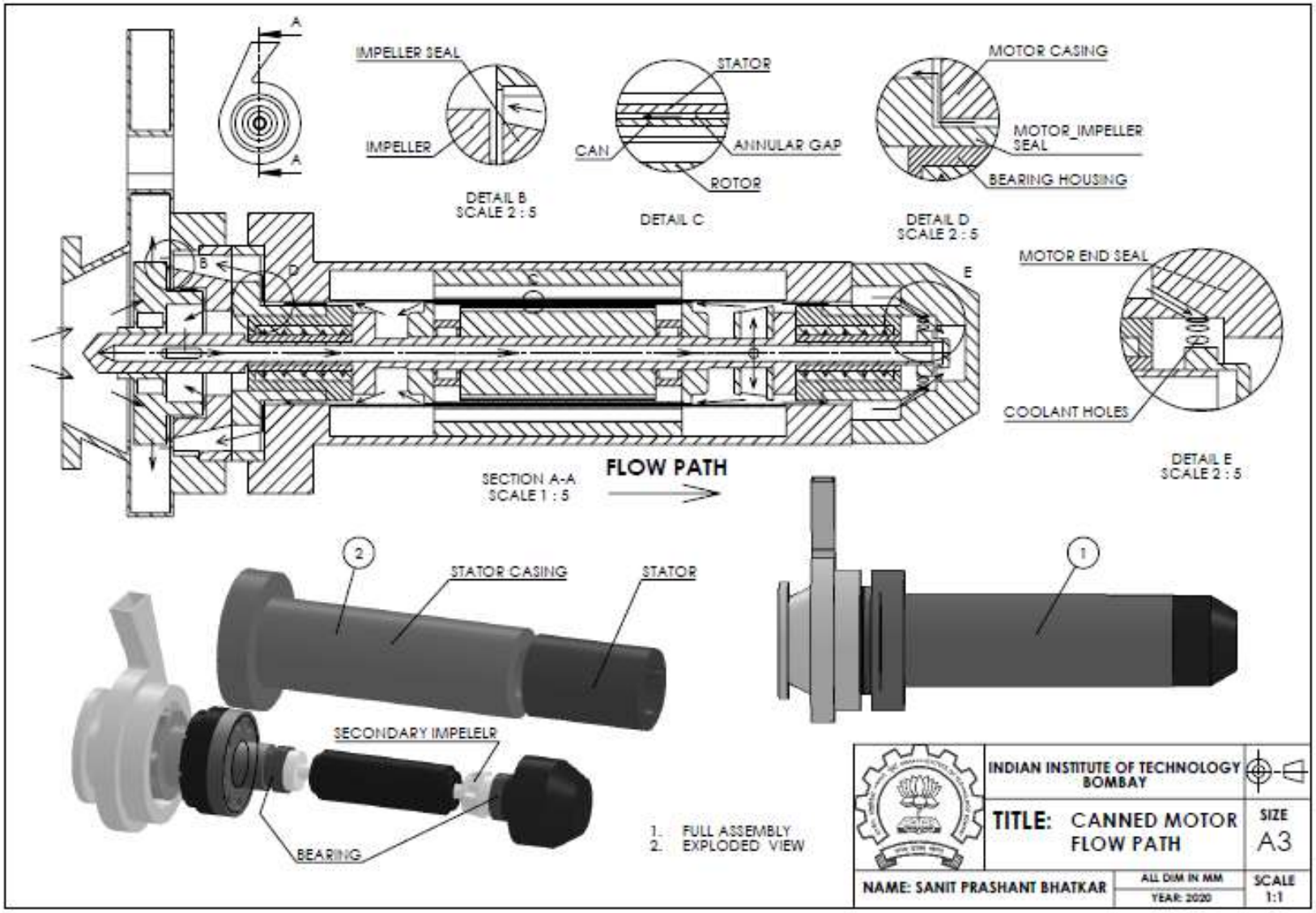

Unsteady Flow Simulation Results




Blade Pass Frequency Harmonics




Sound Pressure Level simulated with COMSOL




Canned Motor Pump Design