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Enhancement of Performance Through Turbocharger Design Modification

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ABSTRACT

The goal of this research project is to boost the power and torque of the present engine. Compressor impeller and turbine impeller modifications have been made as part of this research project. This turbocharger has a dual-impellor compressor with impeller faces facing in opposite directions. With this adjustment, the turbocharger increases the engine's input pressure by compressing the air twice during a two-stage process. More gasoline is required to produce more power and torque as inlet pressure increases. The engine can also be shrunk by using this change. Reduced engine size with the same power and torque is known as downsizing.Only the turbocharger can be modified because this alteration increases power without changing engine size. Here, design parameters for the turbo model GARETT GT4088R with modifications are applied. Using an axial flow turbine instead of a radial flow turbine is another way to look at this research project. Axial flow turbines require low exhaust gas velocities while radial turbines require high exhaust gas velocities to spin their shafts at the same 1,00,000 rpm.It is obvious from this that axial flow turbochargers are more effective because the exhaust gases are forced directly into the turbine wheel, as opposed to radial type turbines, which force the exhaust gases from the side of the turbine and then around the perimeter, producing more heat inside the turbine casing. For engine calculations in this research project, an 1800CC engine with four cylinders is employed. CATIA was used to design the turbocharger, while ANSYS CFD was used to analyse the flow.

Keywords – Power, Torque, Downsizing, Impeller, Turbine, Compressor.

INTRODUCTION

A **Turbocharger** is anexhaust gas driven, force induction device, that expands IC engine power output by pushing extra air into the IC engine cylinder. Although installing a turbocharger will increase the price of the car, this idea is likely to be useful for high-powered engines and situations where the engine needs greater torque, such as racing cars and heavy-loaded vehicles. Additionally, the turbocharger concept is advantageous when engine reduction is crucial. The existing engine needs to be improved in order to enhance power, but as engine size grows, so does the engine's overall weight.

PROBLEM IDENTIFICATION

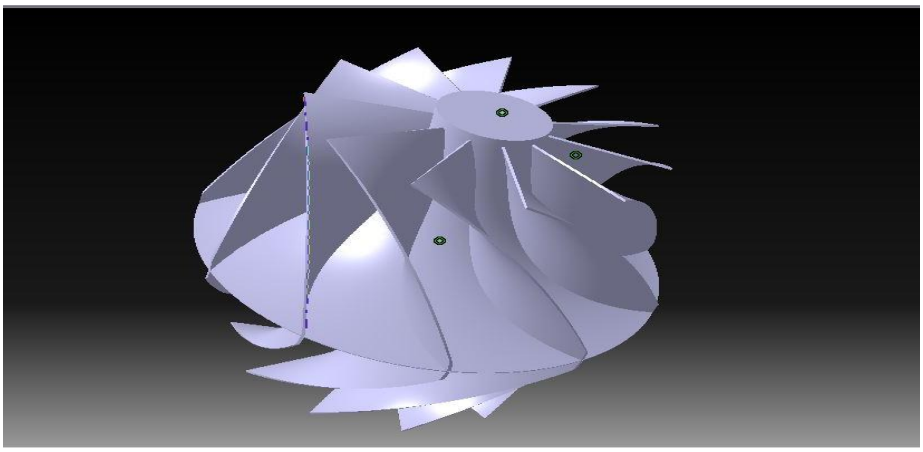
Since a very long time ago, different turbochargers have been utilised to boost the engine's power and torque. However, the increase in power and torque does not seem to be sufficient. Another factor is the size of the engine. The use of a typical turbocharger can reduce engine size only so far; this is insufficient for engine downsizing. The flow of exhaust gas via typical turbocharger turbines is perpendicular to the turbine blades. It requires tremendous velocity to rotate, hence. As opposed to hitting the entire perimeter of the turbine wheel, the exhaust gas only contacts the turbine impeller at one location. By altering the turbine exhaust gas flow configuration, this issue can be solved.

OBJECTIVES

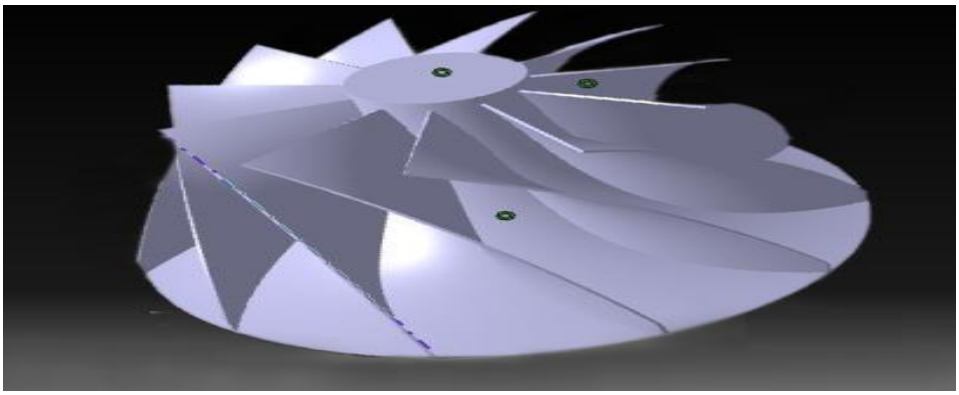
The main objectives in this research work are

1. Modification of Compressor from single impeller to dual impeller to increase inlet pressure of engine.
2. Increase in Power at different RPM of engine
3. Increase in Torque at peak power and different RPM of engine
4. Engine Downsizing
5. Modification of turbine for reduction in exhaust gas inlet velocity in turbine.

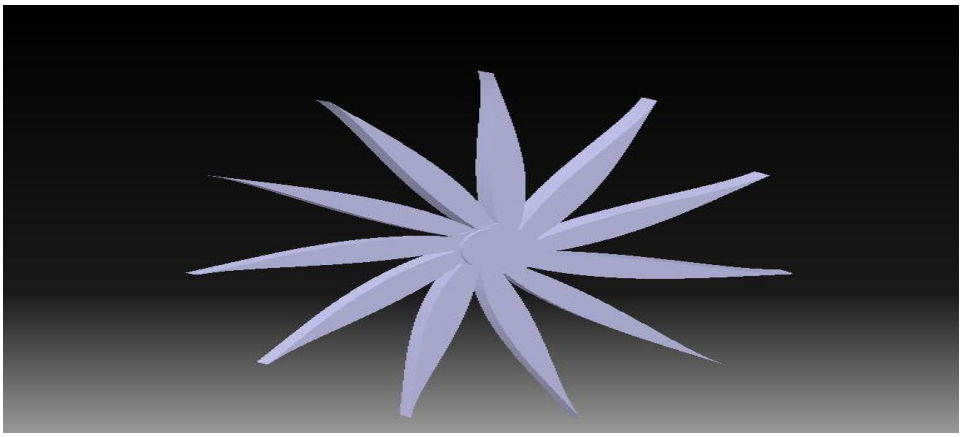
CATIA MODEL DESIGN



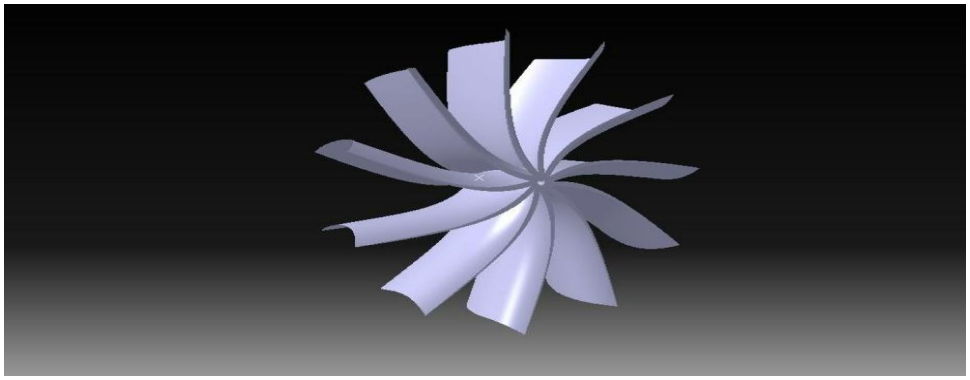
Dual impeller compressor



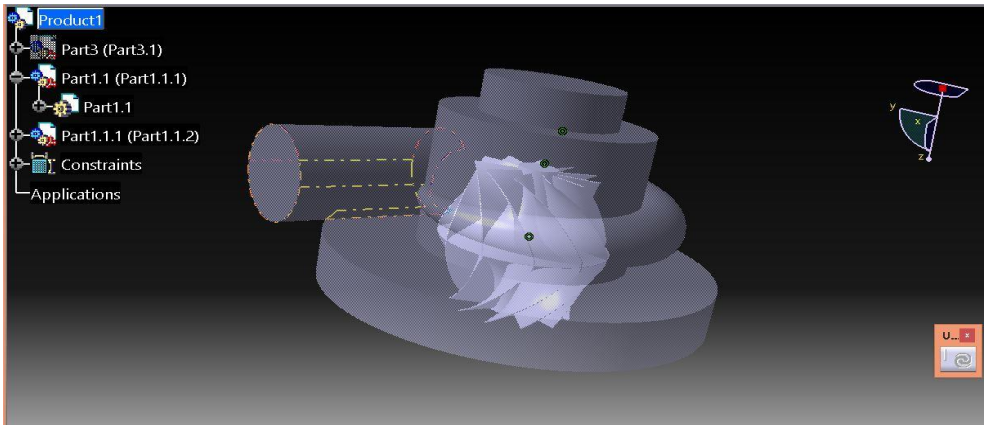
Single impeller compressor



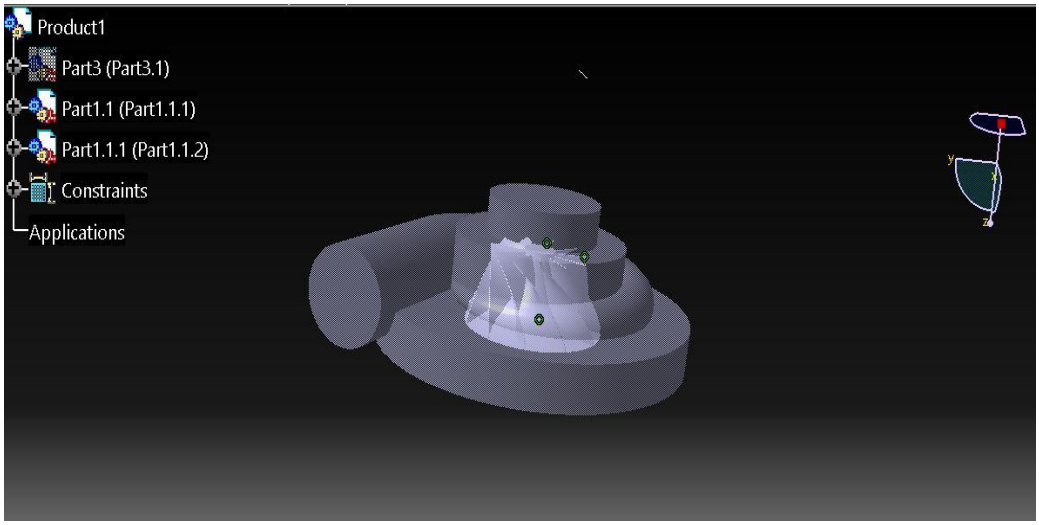
Axial turbine



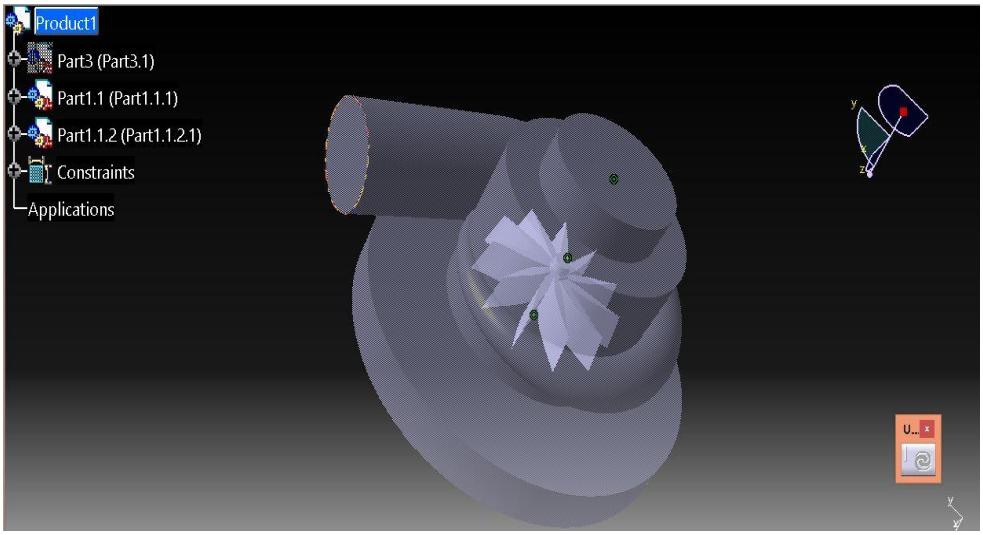
Radial turbine



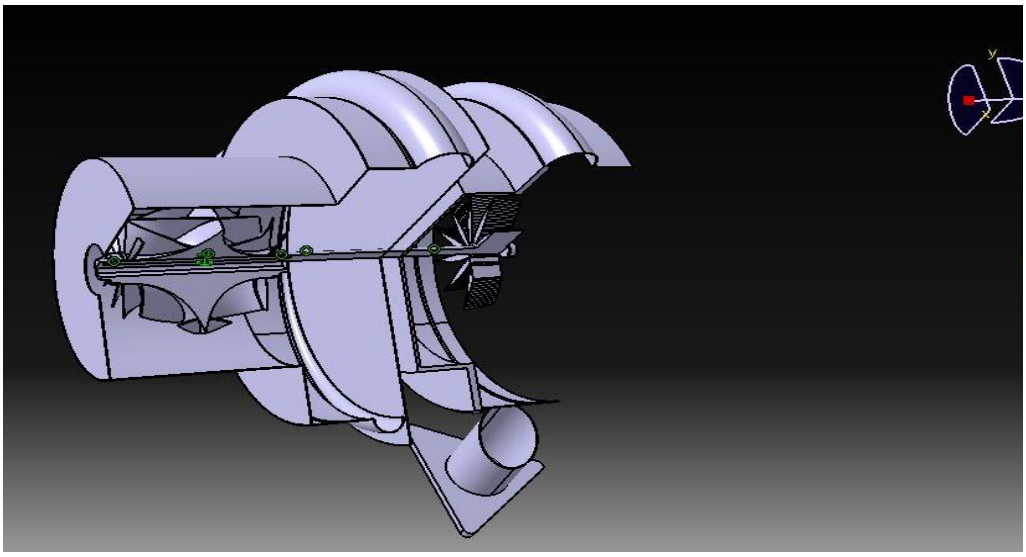
Dual impeller compressor with casing



Single impeller compressor with casing

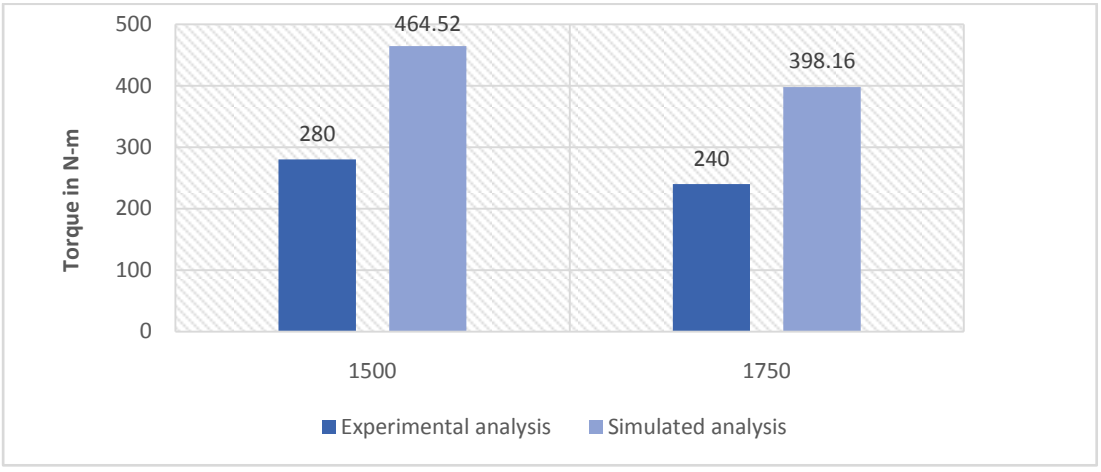


Axial turbine with casing

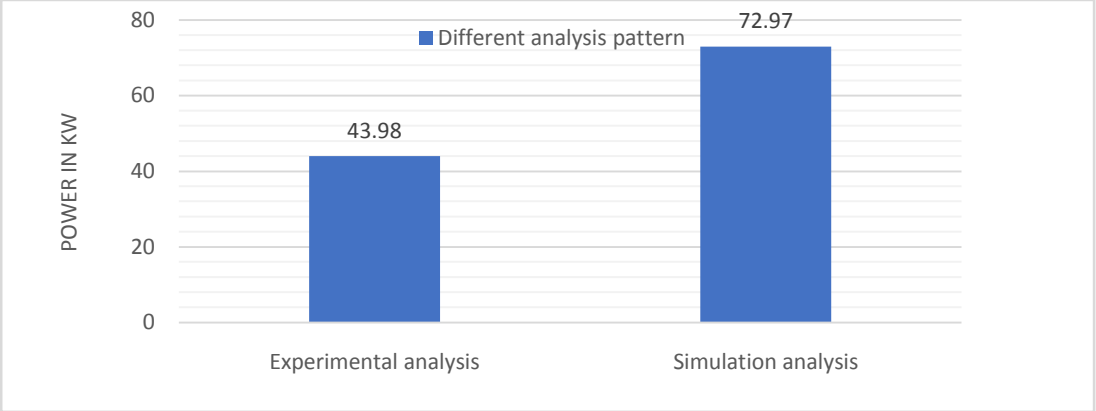


Cut sectional view of turbocharger

RESULT AND COMPARISON



Comparison of torque, experimental and simulated analysis



Comparison of Power, experimental and simulated analysis

CONCLUSION

I. This analysis shows the benefits of dual impeller compressor turbocharger over single impeller compressor turbocharger.

II. This analysis shows that without use of any extra device, other than turbocharger with some modification in existing turbocharger, the pressure developed inside the turbocharger which is going inside the engine in suction stroke can be increased.

III. With this analysis it is possible to increase the engine power of existing engine without increase in its volume or any other modification.

IV. The power can be increased up to 7% with just a modification in impeller and in compressor casing.

V. Torque can also be increase, with modification in impeller compressor as dual impeller compressor can generate more torque compare to conventional type single impeller compressor at particular rpm.

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