



Turbo Range Extender

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Introduction

The electric vehicle is becoming more common place on our roads, a purely electric car is not an option for most people in the UK, the hybrid car is the vehicle of choice to go down the green route.

Electric motorcycles don't have the hybrid option, the weight of the battery and all the ancillaries and an engine would be too much.

Another power generation option is required, it must be small, efficient and most of all light weight.



Motorcycle with turbo, combustor and heat exchanger fitted

The project aim

To design a hybrid motorcycle and analyse the turbo data to pinpoint the most fuel efficient point at which to run.

Keeping the resulting model as aesthetically pleasing as the model picture.

Turbo for a range extender

A turbo when coupled to a combustion chamber can act as a jet engine, this attached to an alternator can generate power with a fraction of the weight and space.

This could be packaged onto an electric motorcycle and be more fuel efficient than its petrol burning counterparts.

Turbo efficiency

A conventional engine has many moving parts a turbo has only one, many parts create a lot of friction but the turbo runs in oil bearings and has minimal friction.

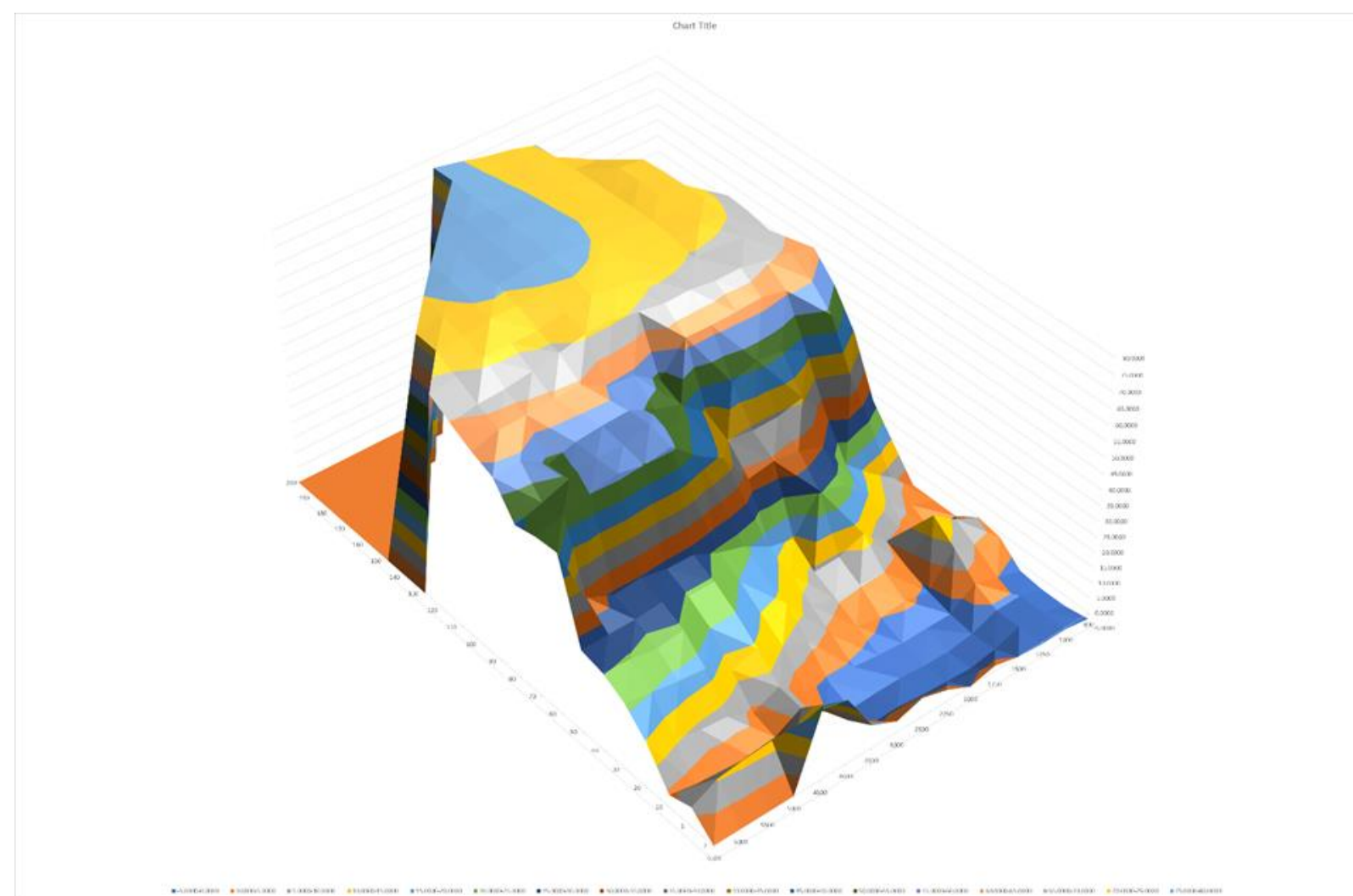
But to make it efficient it needs to be coupled to a heat exchanger which is difficult to package onto the motorcycle but there is a way.

The turbo compressor

A turbo has a compressor end and a turbine end, with pressure and temperature data for the compressor its efficiency can be calculated, The Ford motor company supplied data with which this could be achieved.

Turbine power results

After the compressor is assessed, attention turns to the turbine or hot end of the turbo, the power output calculated from the data is 42Kw, fuel needed to achieve this is 3 litres of diesel per hour at peak efficiency, this system would run on biodiesel but at a lower output per litre.



Compressor efficiency map

Compressor efficiency

On the efficiency map above the high point marked in blue is the most efficient area in which to operate the turbine, the turbo is spinning at 180874 rpm at this stage, below its maximum of 206965 rpm therefore well within its operating limits.

Design

The turbo had to be fully modelled in Solidworks to design all the attached components.

The heat exchanger was designed to maximise the heat transfer from the hot exhaust gasses to the intermediate gas flow leaving the compressor and entering the combustor unit.

The combustor design has evolved using design elements from commercial axial turbines modified to be packaged into a micro combustor.

Material selection

Inconel has been used for many years in the construction of jet engine internals, it is very stable and corrosion resistant at high temperatures.

Acknowledgements

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