

The turbine in a turbocharger operates at a wide velocity range when in operation. Concepts NREC has developed the RITAL software suite to project a simulation of the turbine's operation.

Taking Turbocharger Simulation Further

Concepts NREC develops software tools for turbocharger testing

➤ Many diesel engines being produced or in operation today include a turbocharger — plus, many other engines, whether natural gas, gasoline or biodiesel, include turbochargers as well. Every engine manufacturer and turbocharger manufacturer has its methods for testing and verifying its products. As efficiency demands are higher and higher, and performance is increasingly scrutinized, simulation and performance modeling are becoming more important in the design of an engine.

Concepts NREC (CN), a turbomachinery design and development company, has released its new RITAL turbocharger specific suite of software. RITAL software allows a system level approach to turbocharger design at several different modeling levels.

Nick Baines, distinguished corporate fellow at CN, said the new software tools from the company were developed to aid engine developers in

studying turbocharged engine projects quickly and inexpensively without relying on a lot of outside test data and at the same time with a more complete spectrum of data.

“What people have done in the past is basically to take turbine performance maps from the turbocharger manufacturer, and when they try and use these maps they find that they have to do a lot of extrapolating of the characteristics,” said Baines.

“Normally, you do that by taking the test data and fitting a curve to it and doing some sort of numerical extrapolation. This introduces a lot of uncertainty and considerably less confidence. By using our software tools, we can give you a much better means of doing the extrapolation and filling in the regions of the map that the testing hasn't covered,” explained Baines.

Traditionally, turbochargers have been tested on a gas stand in isolation from the engine, resulting in data

covering only a small range that the turbocharger will actually operate in when part of the engine. On the gas stand, the turbochargers are operating in a steady state, creating a speed line with a limited range of pressure ratios and flow. The limited data gives cause for extrapolation, which may or may not end up entirely accurate.

“What we're doing is giving engineers a better and more confident way of doing the extrapolation, so they can actually handle the turbocharger better and get more confident results,” Baines said.

In real-world applications, the turbine does not operate in a steady state. Every time a cylinder fires, exhaust gas goes through the exhaust manifold and into the turbine, resulting in turbine operation ranging all over the map during each revolution of the engine. Turbines cover a much larger velocity range when in operation compared to steady-state gas stand testing.

Baines said, “Looking at every little time slice of the engine cycle, sometimes the turbine is going to be operating at very high conditions and sometimes it will be very low conditions.”

With the RITAL component software suite, CN said it is able to take the turbine data from the gas stand and calculate the whole performance map, to the extremes of the range that the turbine encounters in actual operation.

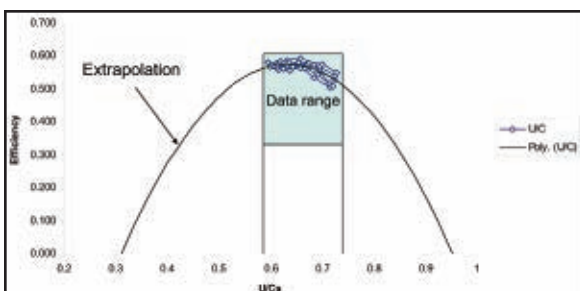
“Rather than having a small amount of data and eyeballing it and saying, ‘Well, I think the curve should look something like that,’ we're actually giving the engineer the opportunity of predicting exactly what that curve should look like over the necessary range,” explained Baines.

The company is working to further advance the turbocharger software suite to account for how pressure pulsations might influence the turbine.

“Engine companies are coming to realize that they can't treat the turbo companies simply as suppliers, but they actually have to involve them in the development process,” Baines said. 💡

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When turbochargers are tested on gas stand, often extrapolation of data is necessary to predict an operating range.