

More sustainable gas turbines thanks to ut research

19 July 2013

The new generation of gas turbines is more reliable, produces less harmful emissions and generates less vibrations and pressure fluctuations. Thanks to the European Limousine Project, in which six different universities (18 doctoral candidates), five industrial partners and two research institutes have been working together for four years, breakthroughs are being realized in this industry. The University of Twente has played a major part in the project with overall coordinator Jim Kok and five doctoral candidates, of whom Juan Carlos Roman Cassado and Can Altunlu will shortly defend their thesis.

"We know of worst-case scenarios in which a [gas turbine](#) was completely destroyed within ten minutes after instability sets in", Jim Kok says. "Because of the value of this kind of turbine, loss in income along with penalties can result in the loss for a power plant amounting to tens of millions of euros. We have been working hard to reduce these risks. The newest generation of gas turbines is ready for the market. Siemens, for example, is now developing the first commercial models."

Marie Curie Action

The Limousine Project has been able to count on a subsidy of 4.4 million of euros from the European Union and falls under the so-called Marie Curie action. This action stimulates cooperation between researchers of different nationalities and promotes excellent innovation in Europe.

Doctoral Research by Can Altunlu

Many [power plants](#) work with gas turbines that generate electricity by burning natural gas. In order to keep the flue [gasses](#) as clean as possible and reduce [harmful emissions](#), the flame temperature must be as low as possible. As the requirements for the emissions become increasingly strict, the flame temperatures continue to go down. Because of this, the flame may become unstable and

produce a lot of noise causing strong vibrations to the components of the gas turbine. This may result in broken parts and the complete destruction of the gas turbine. It is therefore important to know with which speed a crack occurs that may cause the component to break off. Thanks to the tests and computer models of Altunlu, it is possible to design gas turbines in such a way that they can work safely at low flame temperatures while emitting a minimum of harmful substances.

Doctoral Research by Juan Carlos Roman Cassado

The Spaniard Juan Carlos Roman Cassado has investigated Limit Cycle Oscillation, or [pressure fluctuations](#). He has recorded the conditions under which these fluctuations arise, and their properties. The flame inside the gas turbine constitutes a source of sound waves causing resonance in an unstable situation. This is not an issue in an open environment, but definitely one inside a tube. The sound pressure, which can amount to 190 decibels, places a load on the components of the turbine and causes crack propagation. Roman Cassado has worked on his research at the University of Twente in a test set-up. These atmospheric combustion chambers have been copied in Twente and subsequently also used in London, Zaragoza, Stuttgart and Munich.

Lasting Demand for Gas Turbines

"In spite of the boom in wind and [solar energy](#), gas turbines remain indispensable", Kok knows. "There is in fact a high demand for smaller turbines that are able to react quickly. The disadvantage of wind and solar energy is that they cannot be stored. So when there is not enough wind and solar energy available, gas turbines provide a perfect solution. In addition, gas turbines are much more efficient. Moreover, the aircraft industry still only uses gas turbines, as safety is absolutely the most important criteria there."

Kok is very pleased with the outcome of the project. "We have all put our heart and soul into it for four years. I am originally a mechanical engineer and have, in this project, been able to give complete rein to my passion. Gas turbines provide many interesting aspects offering many reasons for scientific research. I have also noticed that the distance between the UT and industrial partners is small, both literally and figuratively. This is a big advantage."

Provided by University of Twente

APA citation: More sustainable gas turbines thanks to ut research (2013, July 19) retrieved 22 November 2019 from <https://phys.org/news/2013-07-sustainable-gas-turbines-ut.html>

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