Project proposal template
Graduate School studentships
March 2015

Project title	Correlation of velocity and temperature within boundary layer around Non-Isothermal Surface of a rotor blade
First Supervisor	Professor — Jian Wang
Second Supervisor	Dr Sing Lo
School	Aerospace and Aircraft Engineering
Other member of supervisory team (no more than three KU supervisors in total)	Dr Peter Barrington
Specific requirements beyond 2:1 degree	This project will be suitable for engineering graduates who are interested in fluid analysis and computational modelling. Experience in wind tunnel testing

Project summary

(max 4,000 characters)

Anti-Icing systems incorporated in aircrafts are essential to ensure the safe working of the rotor. Local temperature distribution along the blade surface will undergo a change when the anti-icing system is turned on. As a result of this, the flow structure along the non-isothermal surface tends to get altered. At the same time, due to the presence of a three-dimensional flow around the rotor, there is need for re-evaluation of non-isothermal aerodynamic performance of the whole rotor blade. Evaluation of three-dimensional effects on the rotor blade, especially when local heaters are turned on, becomes inevitable.

Velocity characteristics inside the boundary layer around temperature-gradient-varied airfoil surfaces will be obtained and studied through wind tunnel measurements and numerical modelling. Comparison with the results from an isothermal wing (or whole rotor blade) will let us study the non-isothermal effects on the airfoil aerodynamics.

By using the same experimental and numerical modelling methods used in study of isothermal airfoil surface, an approximation of 3-D flow structure around rotor blade at different span wise locations under the condition of varied incoming flow speed and temperature distribution on rotor surface can be attained. As a result of this, the velocity profiles within the boundary layer along the entire span wise surface can be deduced. Using the above mentioned methodology, the general aerodynamic properties of non- isothermal rotor can be obtained.

This research aims at the correlation of the velocity and the temperature within the boundary layer around non-Isothermal surface of a rotor blade in 2D airfoils and 3D rotor scenarios. The research is expected to study these correlations at different surface roughness values at different span wise and chord wise locations. In addition, the thermal effect of local heat sources and the heat transfer properties in laminar and turbulence regimes will be investigated to provide design evidences and alternative design solutions for a three-dimensional rotor blade de-icing/anti-icing system. The objectives will be as follows:

- Literature review to understand the state of the art in study of flow structures over isothermal and non-isothermal surfaces, as well as the experimental and numeric methodology in both area
- Conduct investigation of flow structures over isothermal surface using wind tunnel and numerical modelling.
- Examining the methods used in isothermal surface, and applying them in non-isothermal surfaces, modify and improve the methods if necessary.
- Validating and verifying the methods and results.