Turbine technology advancement has far reaching effects on today society and environment. With more than 90 percent of electricity and 100 percent of commercial air transport are produced by the usage of gas turbine, every small advancement in turbine technology is a huge win for the human race. With the limited resources within this beautiful earth and the damaging effect from engine waste, a single percent of engine efficiency transform into decade of raw resources, clean atmosphere, and billion of dollar saved in the global scale.

Within the turbine engine, fully understanding film cooling is critical to turbine engine design. Film cooling is an efficient way to protect the engine surface from the extremely hot incoming gas, much higher than the metal temperature. Film cooling performance directly affects the turbine engine efficiency. Film cooling performance is affected by many factors: geometrical factors and as well as flow conditions. In most of the film cooling literature, film effectiveness has been used as criterion to judge and/or compare between film cooling designs. Uniformity is also a critical factor, since it is determining how well the coolant spreading out downstream to protect the working surface of a gas turbine engine.

Even with the most efficient geometrical factors and best flow condition, the film effectiveness is still affected by the stator-rotor interaction. An all out analysis of end wall film cooling inside turbine is required to fully understand the phenomena. This full analysis is almost impossible in the academic arena. A simplified but critical experimental rig and computational fluid model were designed to capture the effect of wake on film cooling inside an annulus test section. The annulus parameter was always ignored in the past open literature. The ‘wake-film-cooling’ rig was designed to study the effect of film cooling by wakes. The wake is a simplified simulation of the effect of stator-rotor interaction. A 30 degree span annulus end wall test section is considered in this study. This experimental rig is based on the existing basic film cooling (BFC) in-house experimental works, validated by literature. This study provides what the literature is lacking, film cooling within an annulus test section affected by incoming unsteady main stream. The experimental result of wake existence within the test section, in form of pressure and velocity, validated the CFD, rotating wake model. The open literature on film cooling and past experimental validate the CFD film cooling model. With all bases covered, the full CFD model will predicts the wake and film cooling interaction. Nine CFD cases are considered by varying the film cooling blowing ratio and wake Strouhal number.

Major: mechanical engineer

Educational Career:
Bachelor’s of bsme, BS, 2008, University of Central Florida

Committee in Charge:
Dr. Jayanta Kapat, Chair, mmae
Dr. Jan Gou, mmae
Dr. Marcel Ilie, mmae
Dr. Son Ho, mmae

Approved for distribution by Dr. Jayanta Kapat, Committee Chair, on October 8, 2010.

The public is welcome to attend.