Faculty Engineering Technology
Program Mechanical Engineering

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of her MSc thesis assignment

E. Giskes

will give a presentation, entitled:

Design and Optimization of LED Driven Ultra-Fast Schlieren Imaging Set-Up to Investigate Sonic Jet in Supersonic Cross-Flow

Date: Friday January 29, 2016
Time: 13:00
Room: Horst Building Room N.109

Summary:
Over the last decade there is a renewed interest in hypersonic air-breathing propulsion by a scramjet. A hypersonic speed of flight is a velocity of more than five times the propagation speed of sound. Air-breathing propulsion regards propulsion in which oxygen for propulsion originates from outside air. The hypersonic velocity requires a supersonic combustion chamber. To date a successful commonplace scramjet does not exist yet, mainly because of the difficulties of designing a supersonic combustion chamber. Whenever gas is used as a fuel, the behaviour of the jet injecting fuel in the supersonic cross-flow is leading in the success or failure of the engine because in a supersonic flow small changes in the design can induce large variations in the flow field properties. The transverse gaseous jet in a supersonic cross flow has been studied as a model for gaseous fuel injection in a scramjet, providing insight in the fuel injection and the mixing of fuel and air as well as providing data for validation of CFD methods for scramjets.

The high velocity and the unsteady behaviour of the jet require experimental methods that can be used to resolve flow features in the nanosecond time domain. This requirement has for a long time limited experimental investigation of this jet. The improvement of electronical components over the last years has made it feasible to use off-the-shelf and easy-to-access electronics to meet these requirements.

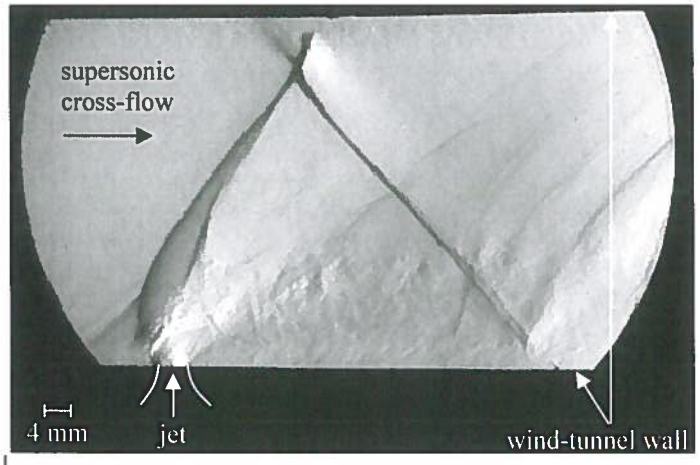

Figure 1 Schlieren image of a sonic jet injecting in supersonic cross-flow made during present study

A new experimental flow visualization set up based on Schlieren imaging has been designed to capture the instantaneous density gradients of a sonic jet in a super cross flow. This visualization set up uses LED light as light source. It is therefore cost friendly and has a large flexibility in usage. The utilization of this LED in the nanosecond time scale has been achieved. An illumination time of 600 nanoseconds has been proven to be sufficient for satisfactory Schlieren images. This illumination time allows sharp images with no motion blur of the supersonic flow in the supersonic wind tunnel of the University of Twente.

The presentation addresses i) the new flow visualization based on Schlieren imaging and its characterization, ii) the scramjet engine and the sonic jet in supersonic flow, iii) the design and characterization of the injection nozzle iv) the supersonic wind tunnel, and iv) the results of the analysis of the obtained experimental data.

Assessment committee:
Prof.dr.ir. C.H. Venner (chairman)
Prof.dr.ir. H.W.M. Hoeijmakers (mentor)
Prof.dr.ir. A. Hirschberg
Prof.dr.ir. T.H. van der Meer
Dr. L.D. de Santana

Chairman,

d.d. 4/1/2016