KTH CCGEx

Flow metering in the gas exchange system

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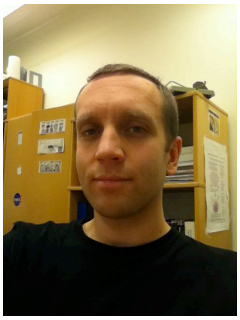
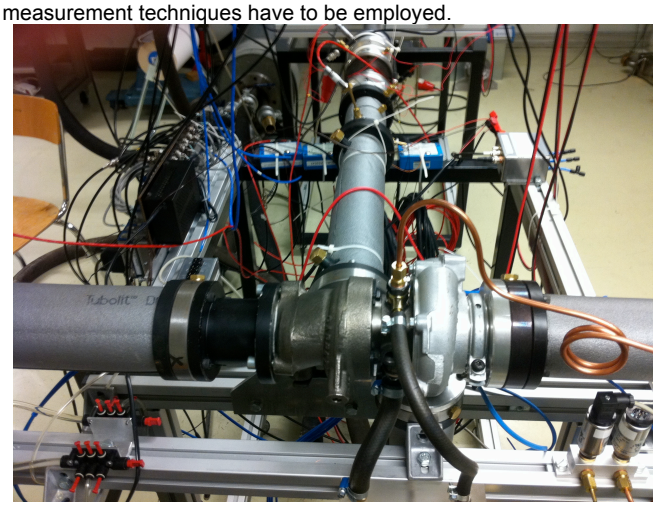


Abstract

The motivation for the present study is found in the use of flow meters for various purposes in the gas exchange system of internal combustion engines. Applications can be found for instance regarding measurements of airflow to the engine, or measurements of the amount of exhaust gas recirculation (EGR). EGR is an important sub system within gas management. A special issue is to be able to accurately measure the amount of EGR even under pulsating conditions. The project started in order to evaluate a flow meter based on the Corona principle, but has been widened to include several different flow meter principles aimed at time resolved measurements including accurate time resolved temperature measurements. Within the project a flow meter based on the vortex shedding behind a cylinder where the instantaneous frequency is determined through wavelet analysis has been developed, and it shows promising results for typical pulsating frequencies of the engine exhaust flow.

Background

Drastic improved performance of IC-engines requires efforts along many lines, where gas management is one important area. Although simulation intensive research and design tools become more and more in use, they still need to be verified through accurate experiments. This is especially so for the turbocharger, an essential component for improved performance that is working in a highly complex flow environment. In the light of this, accurate time resolved measurement techniques have to be employed.



KTH CCGEx flow rig with the turbocharger unit.

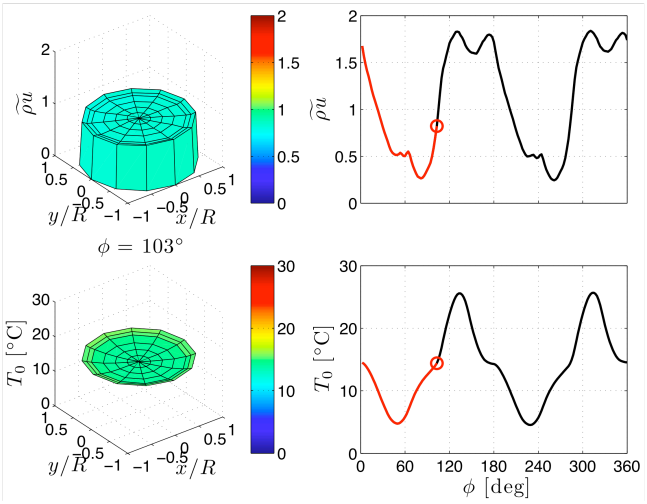
The measurement techniques were developed and tested in a new flow rig, designed for measurement of steady and pulsating air flow with mass flow rates and pulse frequencies typically found in the gas exchange system of cars and smaller trucks. Flow rates are up to about 200 g/s and pulsation frequencies from 0 Hz (i.e. steady flow) up to 80 Hz.

Method

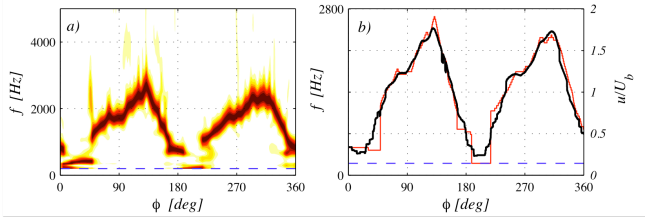
Measurements with the time resolved vortex shedding flow meter [2] were carried out in order to determine the time resolved flow rate through the turbine under pulsating conditions [3]. The measurements were done under various running conditions of the turbine.

Also to characterize the pulsations a hot-wire/cold-wire unit where utilized [1].

Results



Mass flux (upper) and temperature (lower) in pulsating flow [1].



Wavelet spectrogram (left), extracted time resolved velocity (right) [2].

Publications

[1] Laurantzon, F., Tillmark, N. \& Alfredsson, P.H. 2010 A pulsating flow rig for analyzing turbocharger performance. *9th Int. Conf. Turbochargers and Turbocharging*, 19-20 May 2010, London, ImechE, pp.363--372.

[2] Laurantzon, F., Örlü, R., Segalini, A. & Alfredsson, P.H. 2010 Time-resolved measurements with a vortex flowmeter in a pulsating turbulent flow using wavelet analysis. *Meas. Science Technology* **21**, 123001.

[3] Laurantzon, F. Örlü, R., Segalini, A., Tillmark, N. & Alfredsson, P.H. 2012 Experimental analysis of turbocharger interaction with a pulsative flow through time-resolved flow measurements upstream and downstream the turbine. Abstract *10th International Conference on Turbochargers and Turbocharging* (accepted).