



Instrumentation suitability of air mass measurers as direction-controlled flow measuring probes

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1. Problem definition

The main aim of this work was the investigation of a air mass measurers of the company Siemens VDO for suitability as direction-controlled flow measuring probe.

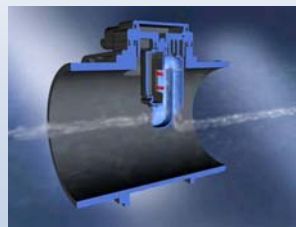
Direction-controlled flow measuring probes are used, in order to determine the amount and the direction of the vector of a current. Usually the probes exhibit the following disadvantages

- very sensitively to external influences
- inaccurately with low flow
- too largely for certain applications
- very cost-intensively



Size of the SIMAF sensor

An air mass measurer, that is used in modern vehicles for measuring the mass flow, does not have these disadvantages. Thus the sensor would be outstanding suitable as direction-controlled flow measuring probe. Also mobile applications as in mobile measuring platforms such as MAV (Micro air Vehicles) would be realizable with the sensor.



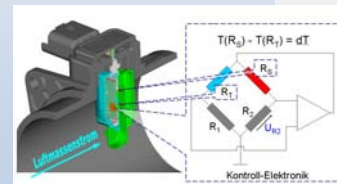
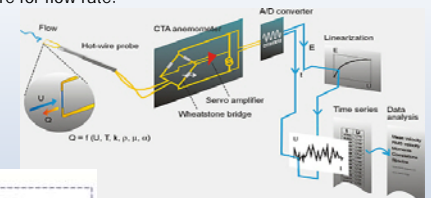
Operational principle of the SIMAF Sensor

2. Operational principle of the SIMAF Sensor

The SIMAF air mass measurer functions according to the principle of the hot-wire anemometry.

This measurement principle based on the detection of changes in the heat transfer of an electrically warmed up body to the fluid flowing around it. If the temperature, composition and pressure of the fluid are constant, the only variable, which affects the heat transfer, is the flow rate. There is the constant temperature method (CTA) and the constant current method (CCA). The SIMAF sensor works according to the principle of the constant temperature method, with which the temperature difference is kept constant from hot film to ambient air by readjusting the electric current. The electric current is here a measure for flow rate.

The current is converted at a resistance of a Weathston bridge connection into a measuring voltage



Wheatston bridge connection integrated in the Sensor

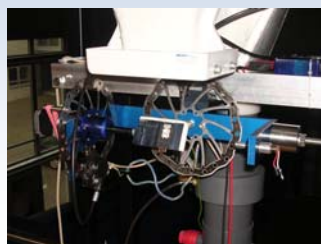
Operational principle of the Hot-wire anemometrie

3. Experimental setup

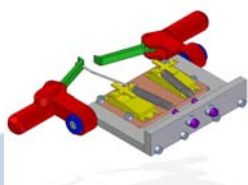
The SIMAF air mass measurer was examined in the calibration setup at the Gunt calibration wind tunnel for its characteristics. In the calibration setup the sensor can be turned with different flow rates around two space axes by stepping motors. Thereby the directionality can be determined and the sensor be calibrated.

Characteristics of the experimental setup:

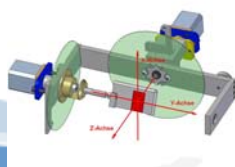
- holding the measuring position with hydraulic disc brakes
- Carrier for the SIMAF sensor and optimization of the flow quality
- Measurement of the flow rate with the help of the pressure gradient in the nozzle of the wind tunnel
- Measurement of the fluid characteristics by temperature and pressure gauges.



Experimental setup/calibration setup



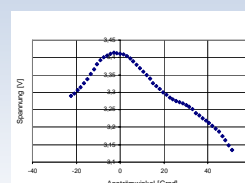
Manipulation of the disc brakes with Servos



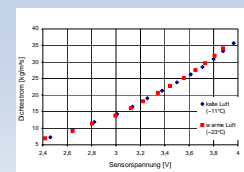
Definition of the axes of rotation at the calibration setup

4. Results

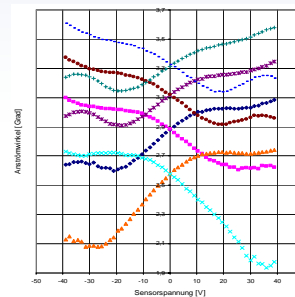
The sensor shows a clear dependence on the flow rate and the flow direction.



Direction dependence of the sensor

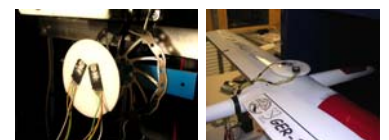


Dependence on flowrate



Characteristic diagram of the Sondenufos

A flow measuring probe was developed, with which the direction of flow and speed are measured. With the help of the „Sondenufo“ stationary measurements, and measurements can be accomplished in mobile measuring platforms. The suitability as probe for MAV (Micro air Vehicles) could be proven by an investigation at the model airplane.



Sondenufo at Kalibriereinrichtung und model airplane

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