**Motivation**

Variable inlet guide vanes (IGV) allow the compressor to operate at high efficiency within a broader range of operating conditions that normally would be restricted by surge and choke. This master project is focused on investigating the flow patterns in the IGV and use them to beneficially manipulate compressor behavior.

**Theory**

The IGV can be turned in order to induce different degrees of pre-swirl in the flow. The pre-swirl alters the enthalpy difference across the impeller as well as the incidence angle at impeller leading edge. Consecutively, this affects the pressure ratio of the compressor and the possible operating range.

**Methods**

The IGV flow patterns are experimentally examined in air as well as numerically in air and R134a by CFD simulations. The results for flow velocity and flow angles are compared with each other, lift and pressure coefficients are validated with reference data from NASA.

**Results**

The flow around the IGV is characterized by a strong blade tip vortex. It influences the axial as well as the tangential velocity component behind the IGV. The flow angle is 60% of the blade angle for both air and R134a. Total pressure losses in the IGV are minimal compared to those in the impeller.

The design point of the compressor could be shifted at constant rotational speed by 2.5% at choke mass flow and by 5% towards surge. The efficiency is held constant and only affected near choke.

The obtained data is integrated in an empirical 1D model of the IGV allowing for fast prediction of thermodynamical and flow pattern related outlet conditions.

**Supervisors**

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