Labor Windkanal/Strömungsmesstechnik

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Automatic Adjustment of the Angle of Attack with the Help of an Actuator

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1. Subject of the thesis

Subject of this bachelor thesis is to implement an automatic adjustment for the angle of attack with the help of an actuator. It is suited for aerodynamic studies of the wing-fuselage intersection of wind tunnel models.

The open test section of the Regensburg wind tunnel (RWT) allows the performing of aerodynamic tests of wing fuselage intersections. In a previous work a test rig was prepared to make such studies possible. Because of the manual angle adjustments for any change of the angle of attack, a considerable amount of time is needed. For this reason a computer-controlled adjustment should be realized.

The bachelor thesis starts with a creation of multiple design solutions and the selection of suitable sensors and actuators. The chosen design will be implemented and manufactured at Regensburg University of Applied Sciences. Subsequently a LabVIEW program is developed that allows angle adjustment automatically.

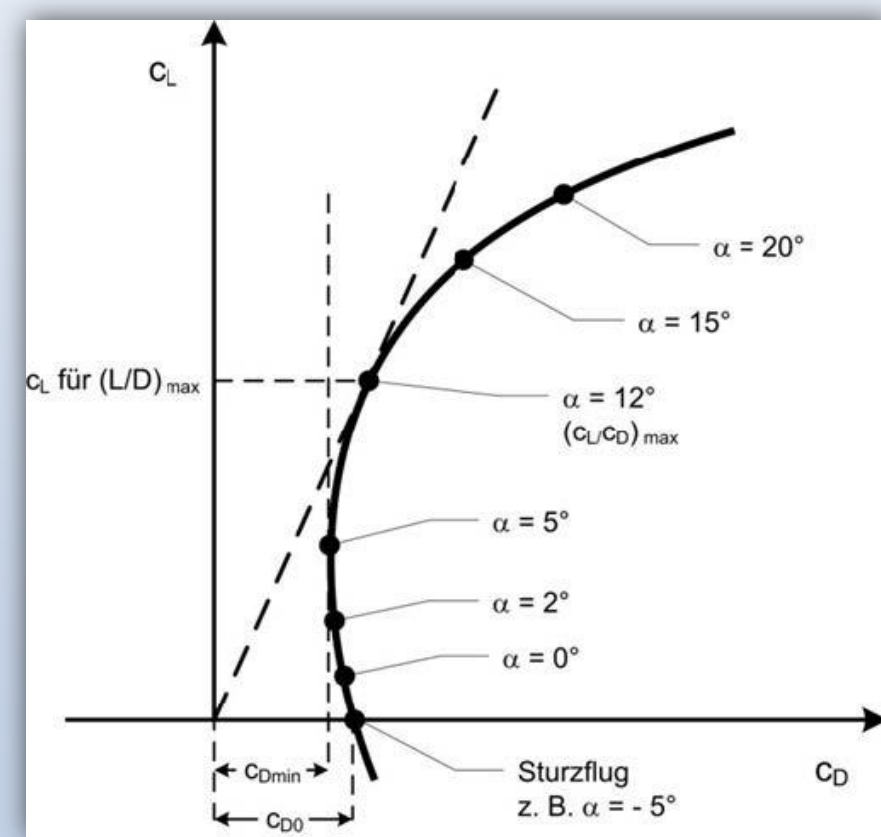Fig. 1: test rig with the manual angle adjustment

Fig. 2: lift/drag polar diagram

2. Design of a new automatic adjustment

Requirements for the automatic adjustment:

- Variable angle of attack between -5° to +20°
- Computer compatibility of the actuator
- Self-locking or braking effect of the actuator
- Rigid construction to avoid vibrations
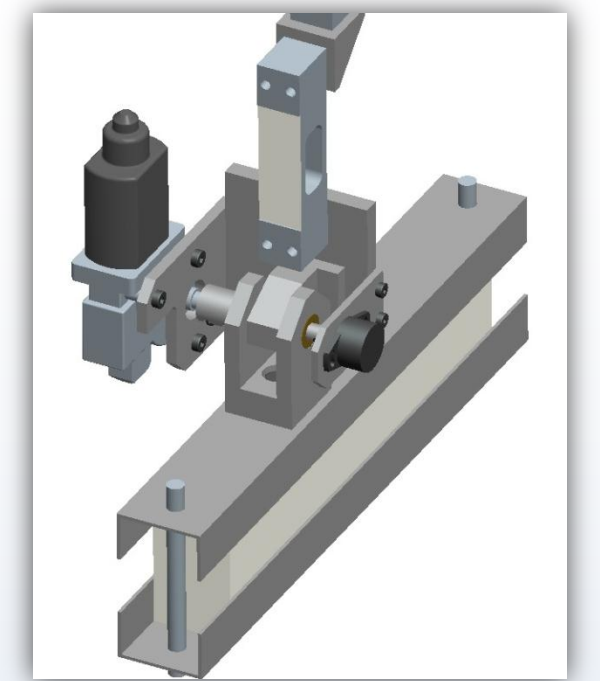- Placement out of the air flow

Components:

- *Doga* DC-motor with worm gear
- *Novotechnik* precision-potentiometer to measure the angle of attack
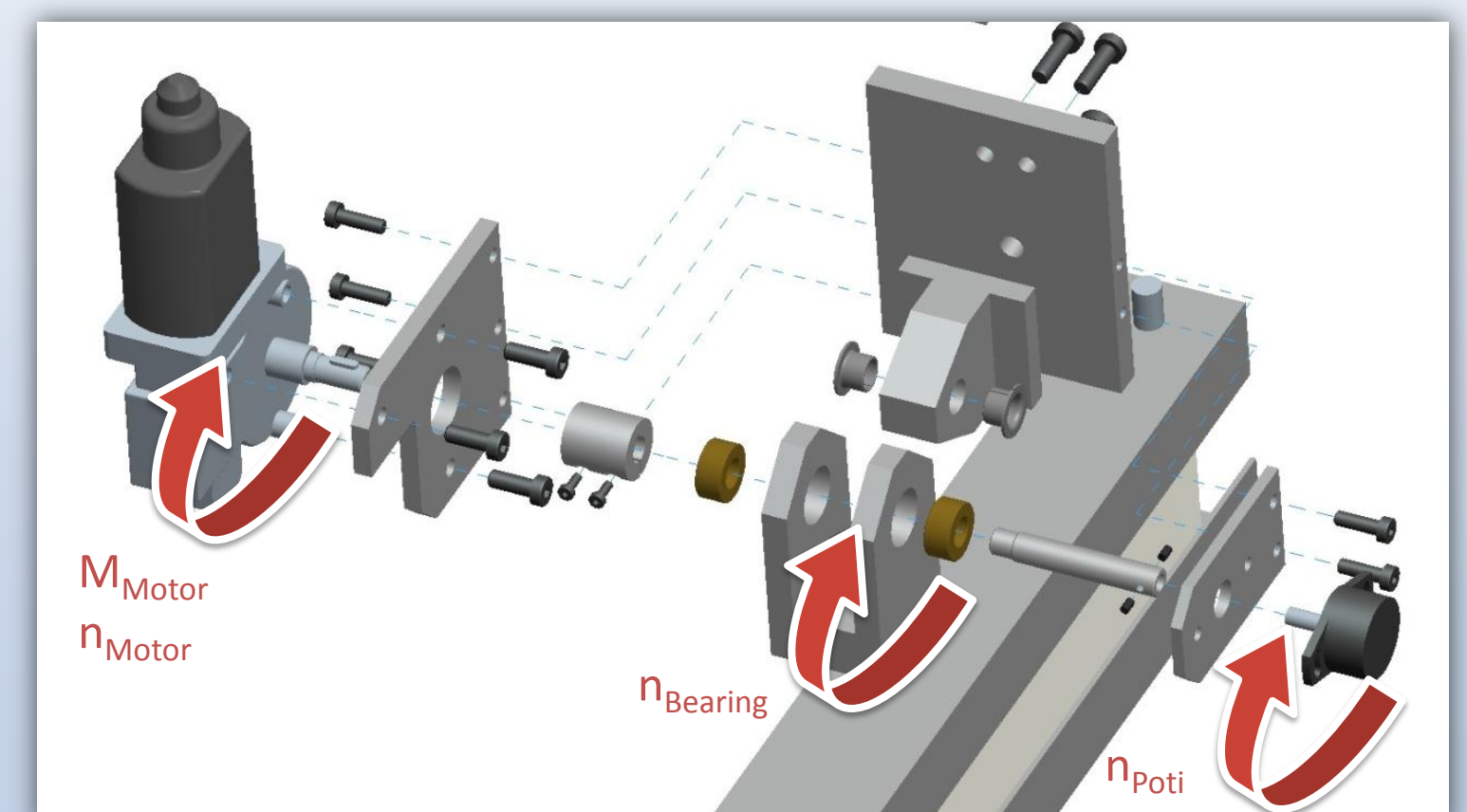- Other parts designed and manufactured at HSR.

Fig. 3: new automatic adjustment

Fig. 4: function of the new automatic adjustiment
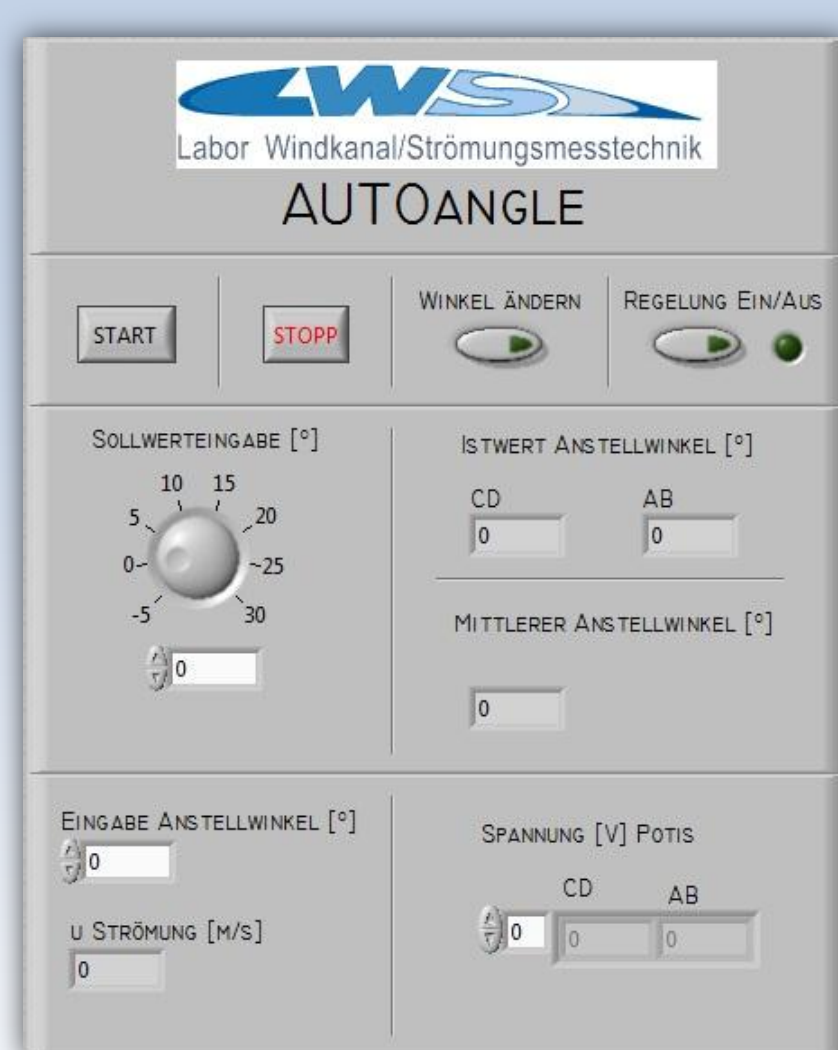
3. Program to control the angle of attack

Fig. 5: LabVIEW program "AUTOangle.vi"

The next step is to write a prgram for controlling the angle of attack.

For this the Software *LabVIEW* by *National Instruments* is used. The program allows the user to enter desired angles of attack and the automatic adjustment of them.

With the help of a microcontroller, the signal of the programm is changed into a pulse width modulated (PWM) signal. To be able to move the motors, the signal is amplified by a motor circuit board.
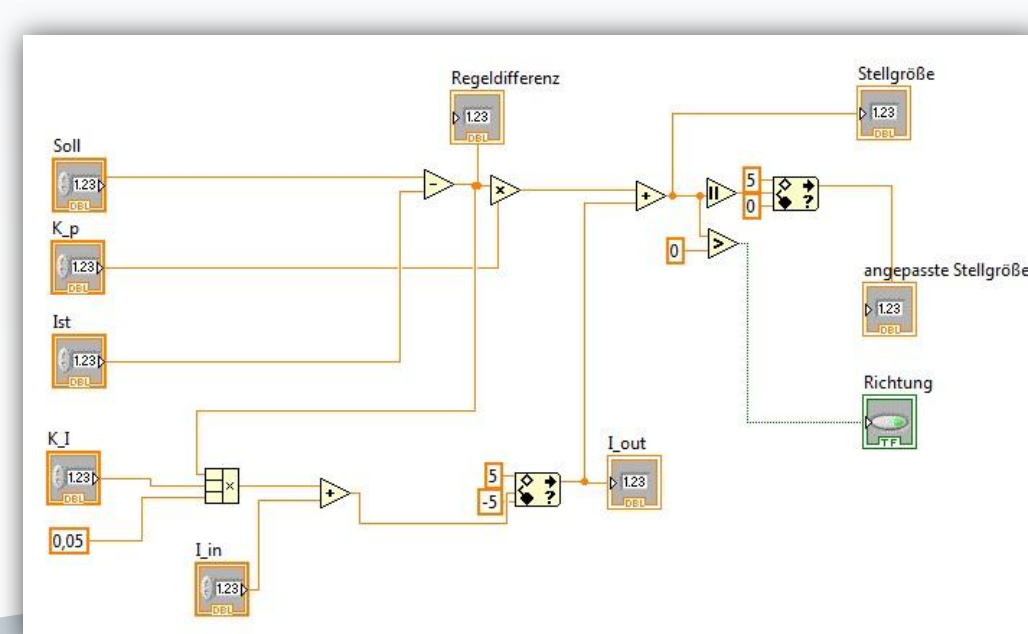

Fig. 6: PI-controller integrated in the block diagram

In the *LabVIEW* block diagram, a PI-controller is integrated for operating the angle of attack. The advantage of a PI-controller is high response sensitivity and no control deviation.

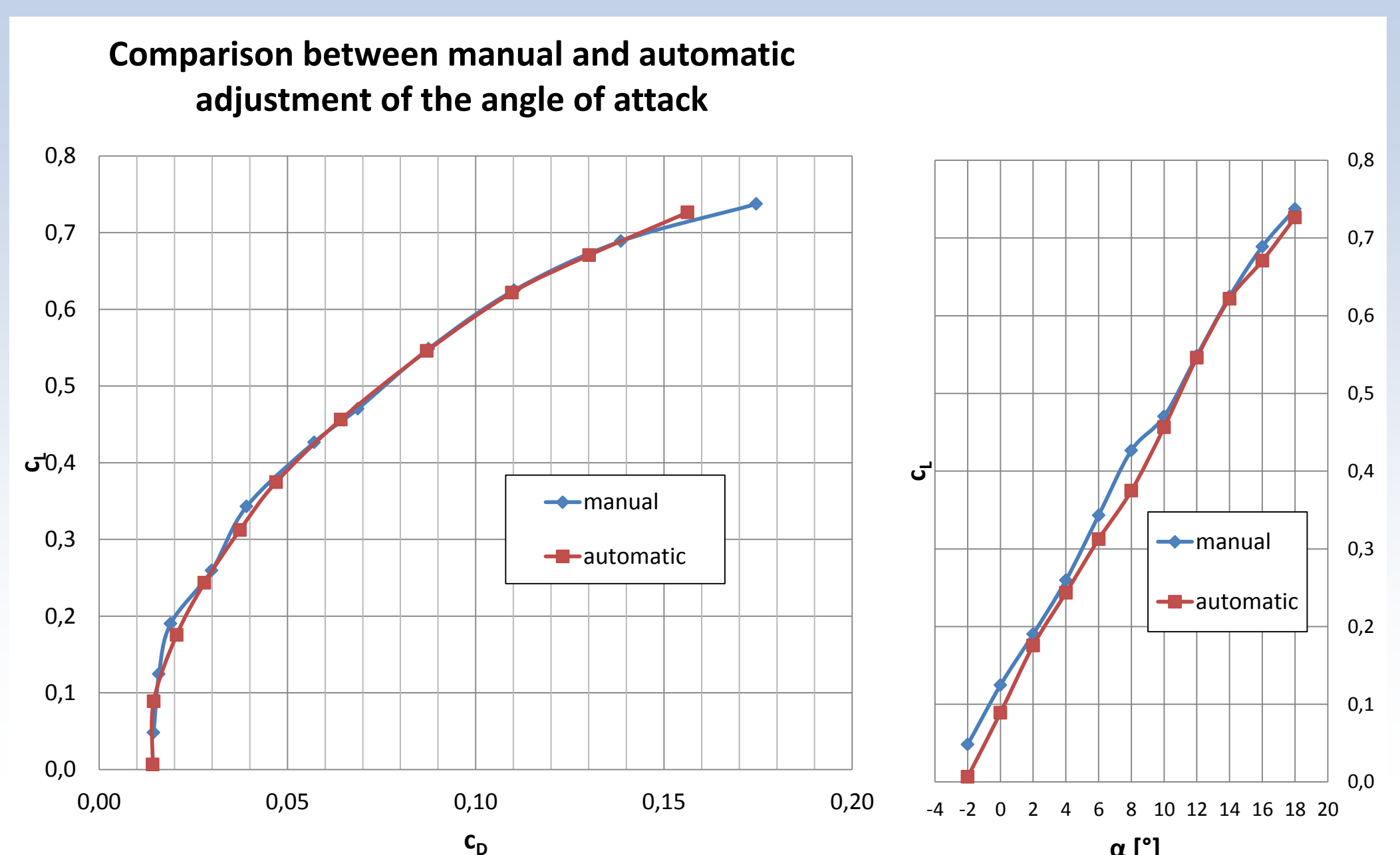## 4. Test measurements with the new adjustment

Fig. 7: lift/drag polar diagram of the wind tunnel model with the manual and automatic adjustment

The aim of the measurements is to get a Type2-Polar. So the wind tunnel model has been analysed over different angles ofattack and wind speeds. Before the measurements can start, the potentiometer must be calibratet. Now, each voltage value of the potentiometer can to be assigned an angle of attack. The measurement provides good results. In contrast to the manual adjustment the waveness of the polar is reduced.

References: Scheiderer, J.: Angewandte Flugleistung, Springer Verlag, Berlin, 2008

Putz, S.: Aerodynamische Optimierung eines Tragflügel- Rumpfübergangs an einem Windkanalmodell, Regensburg, 2011