Automatic Wake-Rake Positioning in the Regensburg Wind Tunnel (RWT)

Nuß, Alexander

alex.nuss@gmx.net
stephan.laemmlein@hs-regensburg.de

Mechanical Engineering, Galgenbergstr. 30, 93053 Regensburg (Germany), Head: Prof. Dr.-Ing. Stephan Lämmlein http://www.hs-regensburg.de/fk/m/labore/562.php

1. Introduction

To determine airfoil-polars the lift and the drag coefficients are required as a function of the angle of attack. The drag coefficient of an airfoil can be obtained by the momentum deficit method. Therefore, the dynamic pressure has to be measured in the wake by the use of a rake of several pitot-tubes (wake-rake). The position of the wake is dependent on different parameters, primarily on the angle of attack of the airfoil and the geometrical airfoil shape itself. For a correct measurement the wake-rake must be positioned at the middle of the wake.
This Z-positioning should be automated.

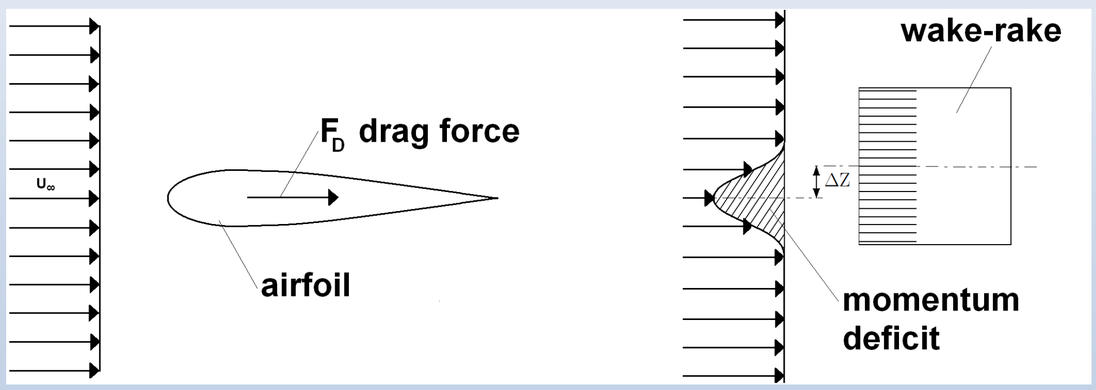

Fig. 1: Wake-rake excentric in the wake, deviation of the required position ΔZ>0

2. Strategy of the Automatic Z-Positioning

The Z-positioning should be performed as follows :

1. The differential pressure between two Pitot tubes is measured with a differential pressure transducer.
2. With the universal measurement amplifier HBM QuantumX (QX) the measuring signal is read in by the program.
3. The program traverses the wake-rake in a new Z-position by switching an electrical traverse device (Flossy).
4. Points 1. to 3. are repeated, until the wake-rake is in the middle of the wake.

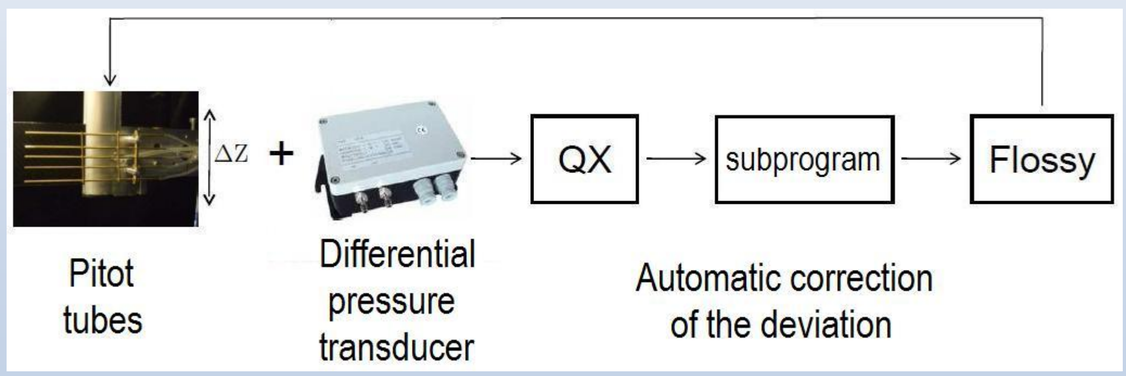

Fig. 2: Strategy of the automatic Z-positioning in the RWT

3. Controling of Z-Position

The positioning program "Z-Positionierung.vi" consists primarily of two subprograms "Finder_Z.vi" and "Regler_Z.vi". "Finder_Z.vi" positions the wake-rake in the wake and "Regler_Z.vi" positions the rake in the middle of the wake via a P controller.

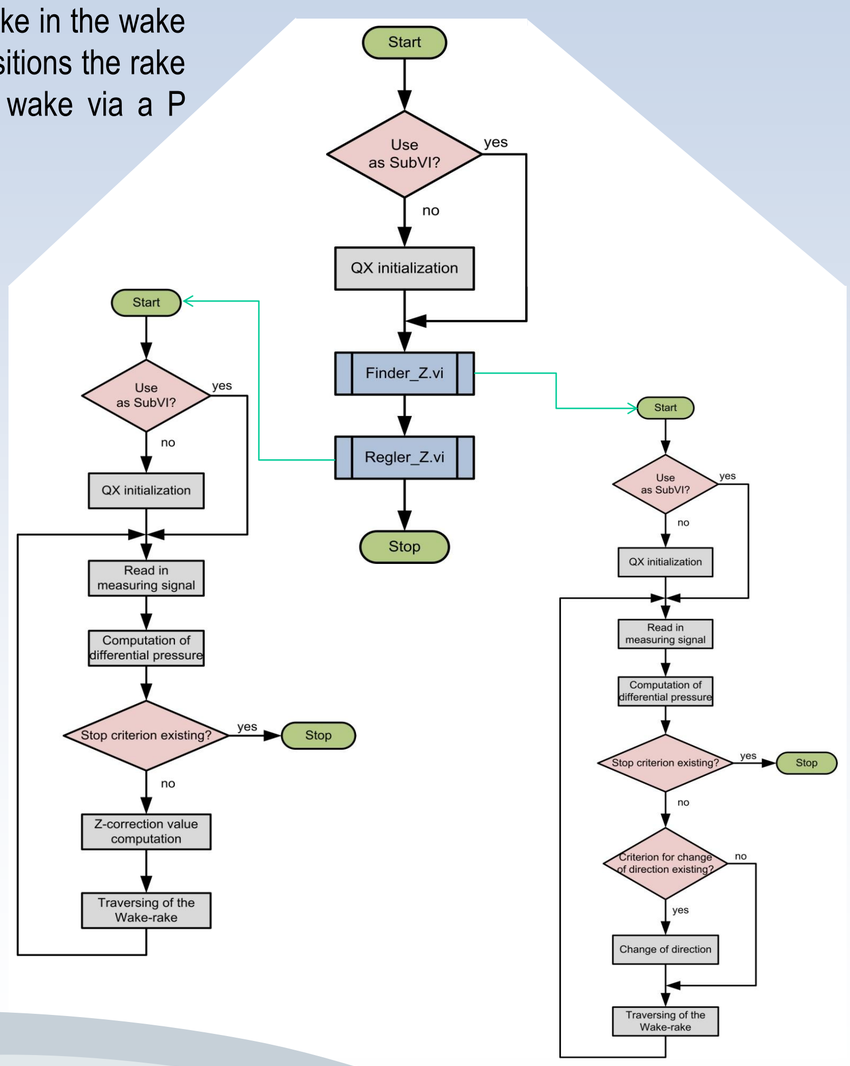

Fig. 3: Flowchart of the positioning program "Z-Positionierung.vi" with the subprograms "Finder_Z.vi" and "Regler_Z.vi".

4. Implementation and Embedding

The automatic positioning was implemented in LabVIEW.
This LabVIEW-program “Z-Positionierung.vi” was embedded as a SubVI in the existing airfoil-polar measuring-program “Setra_Wand-druckmessung.vi”.

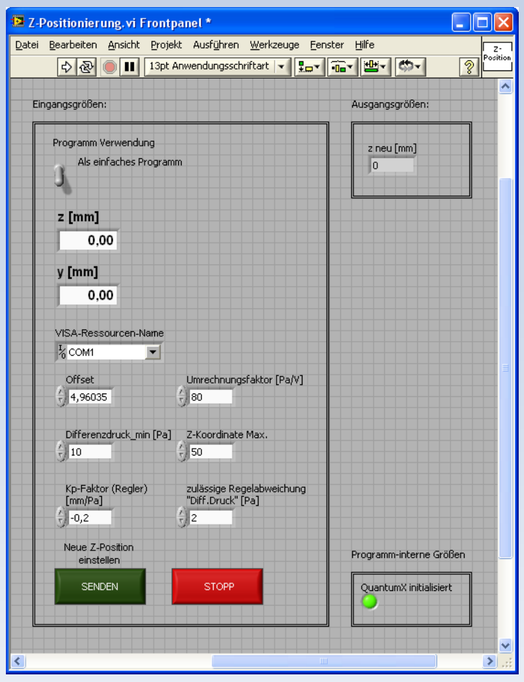

Fig. 5: Front panel of „Z-Positionierung.vi“

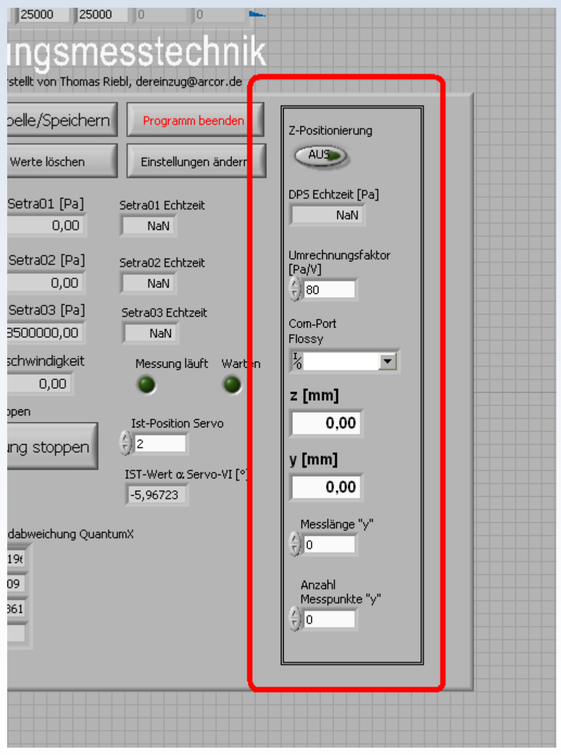

Fig. 4: Front panel detail of „Setra_Wanddruck-messung.vi“ with the plug-in

Furthermore “Setra_Wanddruckmessung.vi” was extended by the automatic measurement at several spanwise locations.

As a result the time needed to work a complete set of airfoil-polars (300 measurement points) has been reduced from 7h to 3h by this automation method.

References :

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