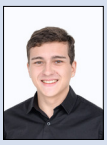

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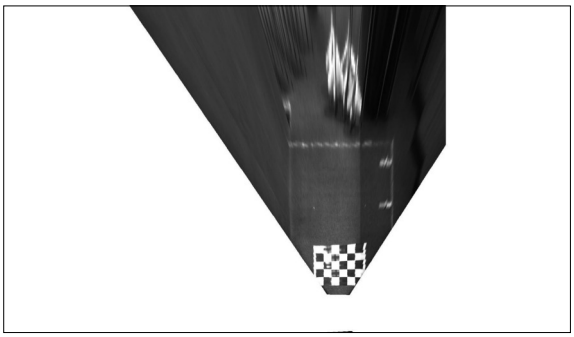
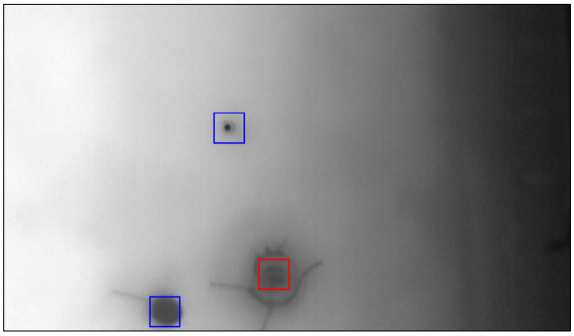
Subject Area	Digital Image Processing
Project Partner	IMITec GmbH, Meilen, ZH

Automated Non-Destructive Structural Testing for Airspace Applications

Concept of the functionality of the robot



Calculation of the robot's position through optical cameras



Evaluation of the thermal images and structural features (blue: water, red: feature)

Introduction: A common problem of airplanes is the accumulation of water inside the honeycomb structure of the rudder. While the airplane is on the ground, it is affected by climate conditions, especially the humidity. During the flight, the humidity condenses inside the structure and additional water finds its way to the inside. That is problematic because the temperature drops below the freezing point. As the water freezes, its volume increases. The honeycomb structure cannot withstand the pressure and it breaks. To find such damages, non-destructive testing is used. The testing is usually done manually by two technicians on a crane. This method has a high-risk factor for damaging the airplane structure and is time demanding.

Objective: The detection of potential damages is done by analyzing thermography images of the airplane structure. The idea is to improve such testing, by using a robot. Moreover, the robot should be able to climb automatically on the airplane, define its own position, take thermography images and store them.
The goal of this thesis is to create two algorithms: a positioning algorithm and a processing algorithm, which merges all thermography images and provides the means for damage and feature detection. In addition to the algorithms, a graphical user interface should be created for analyzing the features and give the user the possibility of changing its attributes and to create a log file with all the information.

Procedure / Result: The hardware used to capture the thermography images was provided by IMITec, hence the focus of this project is mainly on the algorithm. For the positioning, a prototype is created and various camera types and camera positions under different light conditions are compared, to provide an optimal resolution for the calculation.
A graphical user interface is designed to display the detected features, damages, and the merged images. Additional features are implemented, allowing the user to analyze all the images, to add, change or remove features, and to create a log file.