Vision project within AkzoNobel Automotive & Aerospace Coating in Sassenheim

1. Introduction

The Physical and Analytical Laboratories in Sassenheim were founded in 1939 and have played an important role in the development and production of our coating products since. Over the years, capabilities were expanded with a Microscopy Laboratory, an Expertise Group and a group specialized in High Throughput Experimentation (HTE). All groups are now part of the R&D Service Unit of Automotive & Aerospace Coatings (A&AC).
The groups within the R&D Service Unit of A&AC maintain a wide range of technical capabilities and expertise to support our customers in the field of coating research. Over the years we have developed particular areas of expertise where the combination of technical skills is crucial. The strength of the combined Physical, Analytical, Microscopy, HTE and Expertise groups lies in our ability to pull these skills together to meet the needs of any given customer problem related to coatings.

2. Target

The goal is development of machine vision applications for our Physical Laboratory.
This lab carries out hundreds of visual judgments per month. It involves determination of rating scores for cracks, blisters, delamination, haze, etc. on coated test panels according to standard methods (ISO, ASTM, Volvo, ...).
We are in the process of developing vision applications. To reach the target at least another five years of research will be required.
The development of proprietary vision methods arises from the fact that commercially available instruments fail to deliver satisfactory test results.

3. Approach

The vision project is split into separate subjects relating to the kind of test method.
Two of these sub-projects can serve as subject for a master's internship.

Sub-project 1

Judgment of WOM and UVCON test panels by means of machine vision

WOM and UVCON are artificial climate cabinets, in which coated panels are tested on their resistance against UV, humidity, and temperature changes. At specified time intervals the panels are visually judged on defects (combination of concentration, size, and shape) by lab co-workers. After the test, defects can change making it difficult at a later time to compare the score and the panel self. The vision application should capture images for historical record and carry out the judgment.
An example image is shown in figure 1.

Sub-project 2

Judgment of steam cleaned panels by means of machine vision

The coating on a test panel is deliberately damaged (weakened multi-layer paint system) by cutting a cross on it with a knife unto the substrate. Then the adhesion of the paint system is tested by jet spraying the damaged area with pressurized hot steam. The amount (mm^2) of delamination and indication of the interface (single or multiple) at which adhesion failure took place forms a judgment score. The interfaces can be distinguished because they interact differently with light resulting in different appearance properties (color, gloss, texture).
An example image is shown in figure 2.

Hardware
A prototype imaging instrument is available.

Software
Develop image analysis methods in Halcon (from MVTec) or Matlab software to determine the score of an image texture/defect parameter. The scale of the score system can be different from the one currently used, and new parameters can be selected to be a score. Statistically compare IA results with visual scores. In this development phase we aim for 90% correlation.

4. Student requirements

The student should understand the physics involved in visual appearances on an academic level. The physical nature of surfaces and light and the result of their interaction which is observed by a camera or human eye is the basis of vision. The meaning follows by the interpretation of image analysis parameters with a computer or signal processing of the human brain.
The trainee should be an experienced user of standard computer programs like the MS Office package. Knowledge on image analysis and computer programming in general is a must. Halcon or Matlab scripting is used to develop prototype image analysis scripts. Currently, we use Halcon for control of camera settings during execution, many IA functions, and fast processing. The scripts can automatically be converted to executable languages like C++, Visual Studio, Delphi, VB6.
The reporting language is American English.

5. Remuneration

The fee that AkzoNobel pays to academic students is about € 700 per month.

Figure 1. *Example image showing defects on a WOM test panel*

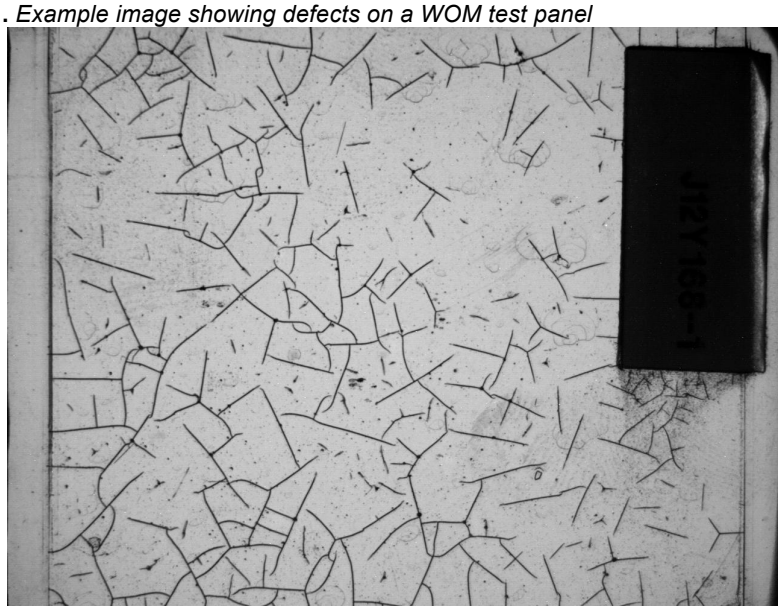

Figure 2. *Example image showing loss of adhesion at multiple interfaces on a steam clean test panel*