

# AIRLINE + UNIVERSITY: AN INNOVATION FACTORY



**Example I**  
**Example II**  
**Example III**

# About me...



**Michael Stamm**

NDT researcher &  
MSCA Fellow



## NDT Researcher

- Development of a water & ice detection system
- Project management



## PhD Candidate in material sciences

- Supervising thesis
- Perform scientific experiments and publish papers



## MSCA Fellow

- 100% EU funded position und Horizon 2020



## Flemish funded R&I project partner

- Coordination of DETECT-ION project



## M.Sc. in Physics

- B.Sc. thesis in Detector physics
- M.Sc. thesis in Geophysics



# Example I

## Example II

## Example III



Photo: Samir Patel

# Corroded floor beams



brussels  
airlines

Cooperation since 2008

**KU LEUVEN**

Student project about corroded floor structures



## Corroded floor beams

# Problem

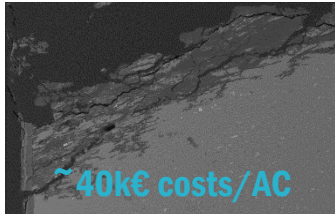
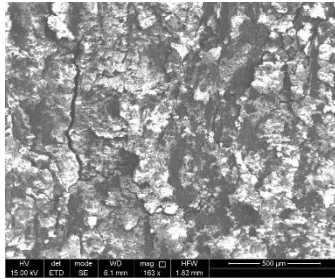
corr. floor beams



# Investigation

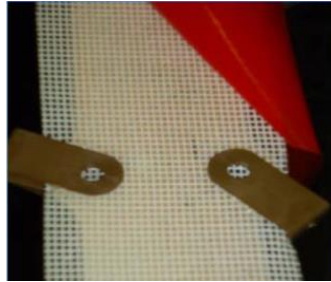
## Fractography

### chem. analysis



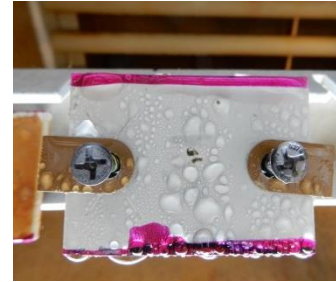
## Action

Av-DEC HI-TAK®



# Test

## Repetitive tests



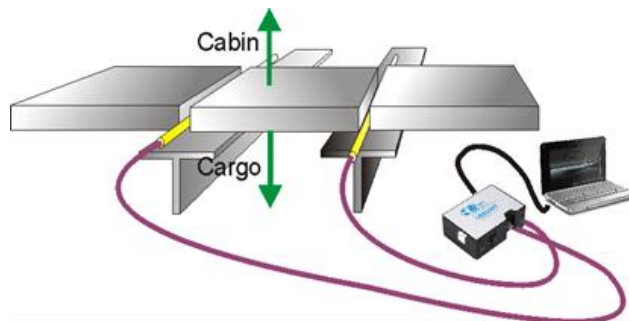
## Implementation

~ 8 k€/AC





# Percolation sensor



## Implementation by LHT

- D-ABIX (B737)
- D-ABVX (B747)
- D-ABVM (B747)



**KU LEUVEN**



**Lufthansa Technik**

**Eurowings Group**



03/2012

**Connection**  
The Lufthansa Technik Group Magazine

Lufthansa Technik

3-2012 May/June

Training for the next generation

Technology  
Anti-aging for fan blades  
Innovation  
Cabin lighting redefined  
Employee portrait  
"Seeing the bigger picture"

Sensor for confined installation Technology

The present invention chemical installation within the material is small size and the o  
Keywords: water lea

Background &

BACKGROUND In aircraft  
splurge, condensation of  
in heavy corrosion of the  
case for the so-called floor  
cabin. A reliable sensor  
is integrated at least of  
frequently, could help to  
costs considerably. An ar  
of sensors in the floor be  
available. Furthermore, t  
area.



RESULTS Sorption exper  
conductivity could be triggered, or at least provided by a  
hydropic glass-fiber transition in the hydrophilic matrix.  
The sensors were finally qualified and implemented in  
different operational airlines (Boeing 737-500 and Boeing  
747-400). The electrical resistance is recorded in time  
intervals of about 100 flight hours. At the moment, several  
"damage cases" have been reported providing evidence  
of areas with malfunctioning sealings. That areas require  
inspection and repair of sealings to prevent major corrosion  
damage at a later stage.

### Summary: AISHA

Lufthansa Technik has installed mois-  
ture detection sensors developed at the  
Leuven University, Belgium, in a Boeing  
737 and two Boeing 747 aircraft.  
Installed in critical places, so-called  
"hot spots", they are able to defer or  
eliminate a structural inspection, reduc-  
ing aircraft ground time and costs. //

Example I  
**Example II**  
Example III



Photo: Samir Patel





# NDTonAIR

## Problem

Water and Ice  
in fuel tanks



## NDTonAIR

EU funded (H2020)  
research project

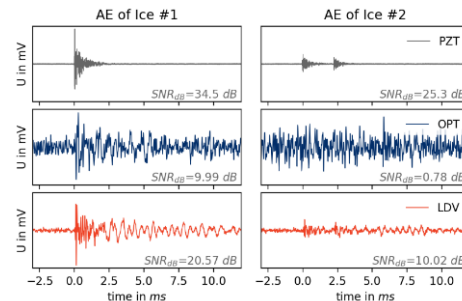


250 k€



## Achievements

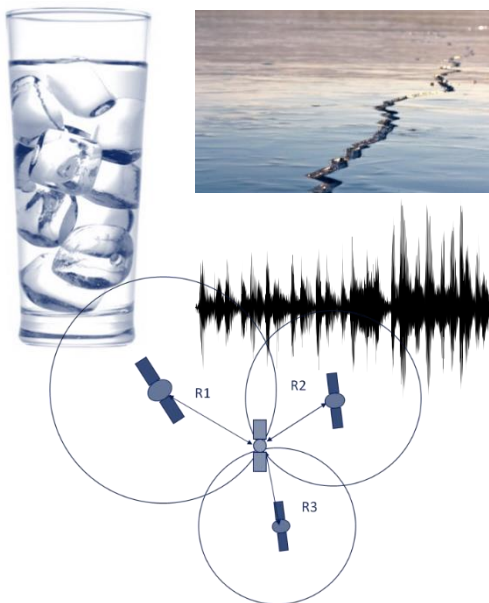
Scientific conference  
presentation



# NDTonAIR

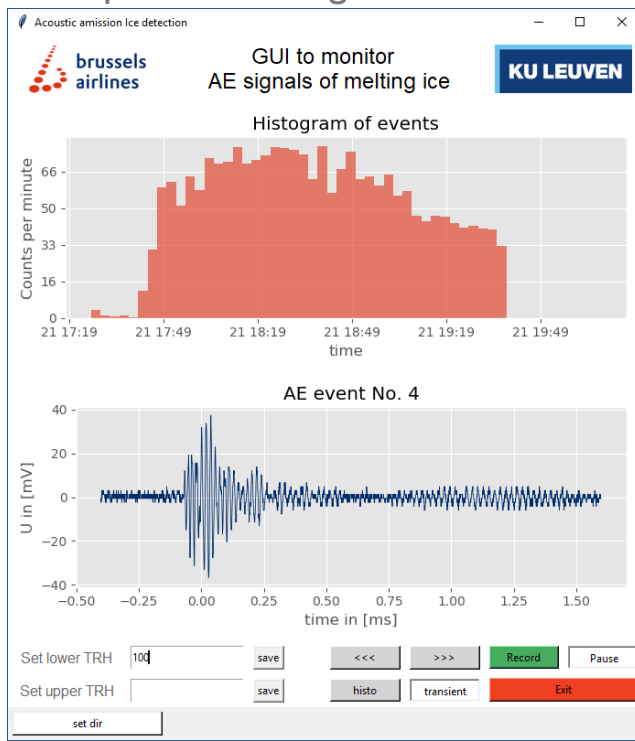
## Approach

### Acoustic Emission



## Current status

### Up to three signals/second



## Goal

Ready to use  
measurement tool

Better understanding  
of ice in fuel tanks



Example I  
Example II  
Example III



# DETECT-ION

Until now:

Problem

Investigation

Action

...

Proactive innovation:

Technology

Application

Development

Prototyping

...

Development of DIC tool as a  
standard aircraft maintenance tool.



brussels  
airlines

**MatchID**  
Metrology beyond colors

220 k€



**SIEMENS**

Eurowings Group





# DIC principle

Digital Image Correlation



# DIC principle

Digital Image Correlation



[pixabay.com](https://pixabay.com)

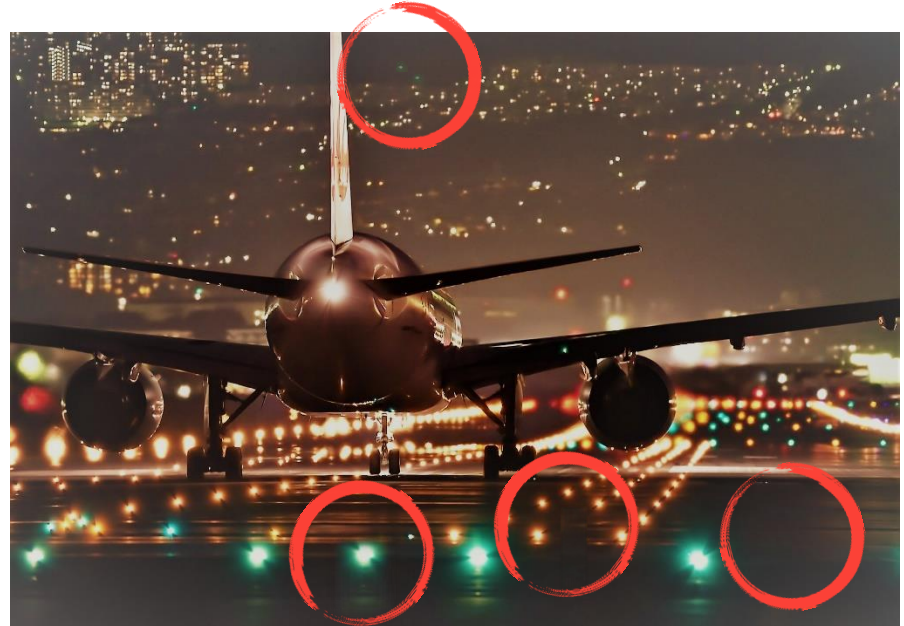


# DIC principle

Digital Image Correlation

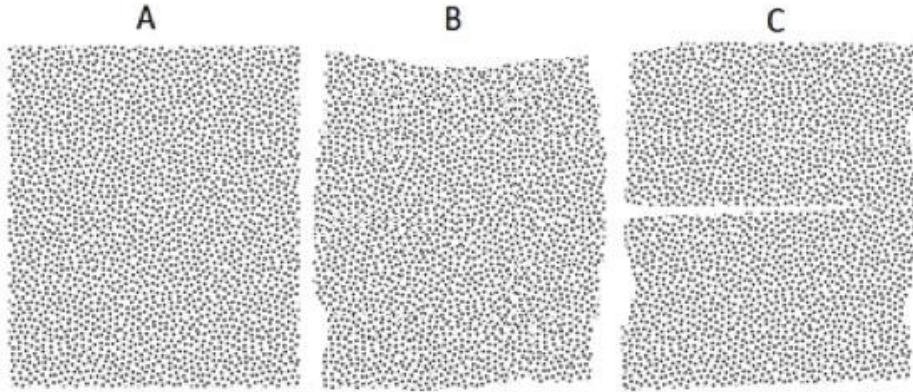


[pixabay.com](https://pixabay.com)

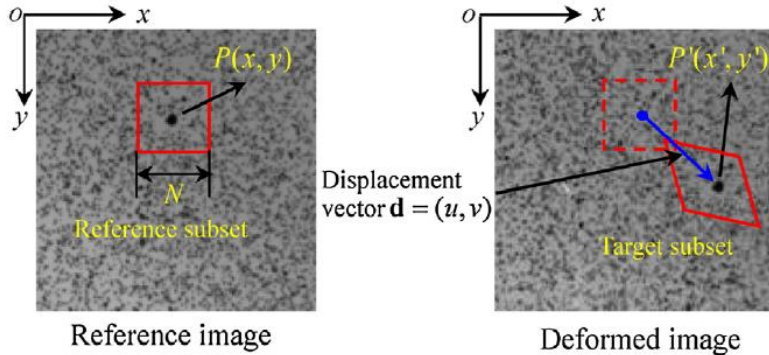


# DIC principle

## Digital Image Correlation



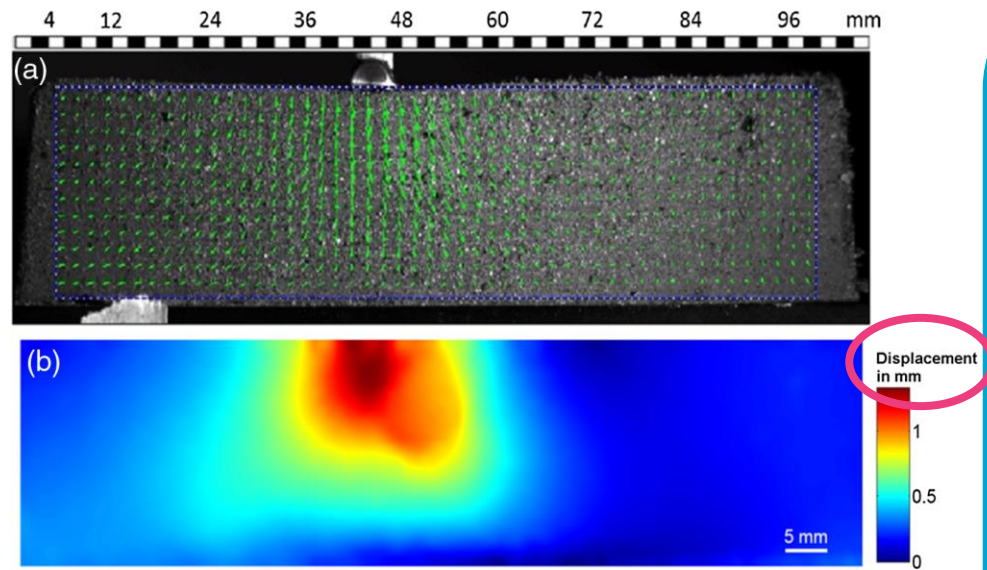
- Compare reference image with actual image





# DIC principle

Digital Image Correlation



Until now:

**2D displacement + reference image!**

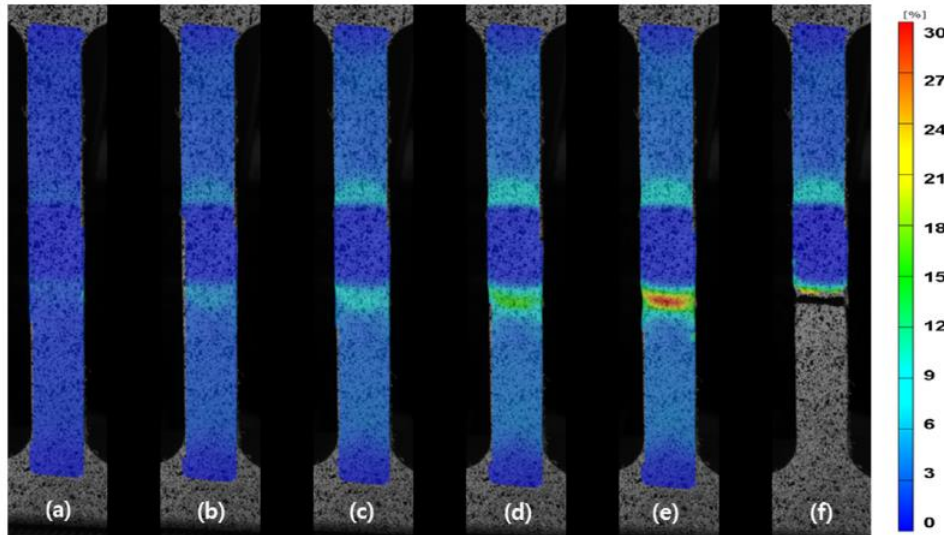
- Compare reference image with actual image
- Calculate displacement



# DIC principle

## Digital Image Correlation

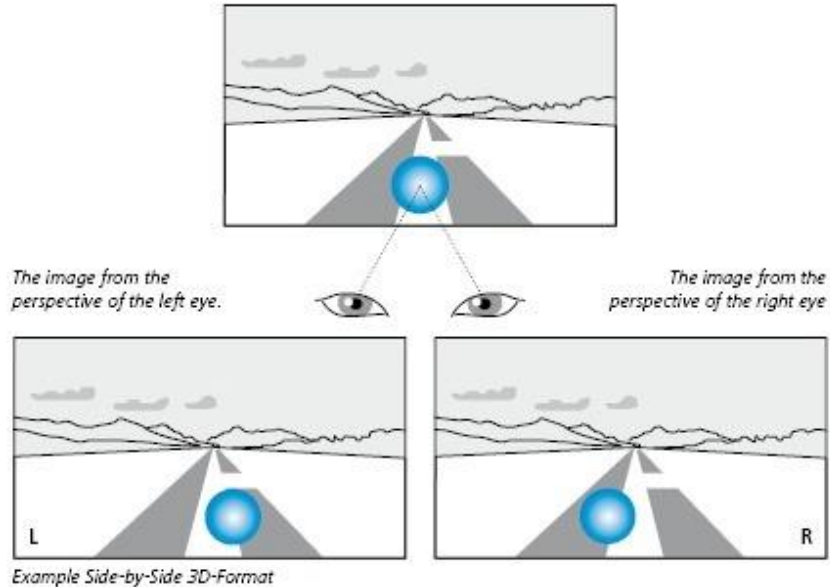
Strain calculated using material properties  
(thickness, strength, length...)



- Compare reference image with actual image
- Calculate displacement
- With material properties:  
Calculate strain and stress

# From 2D to 3D...

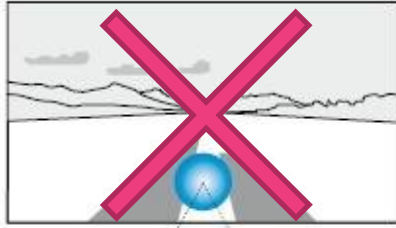
## 3D image reconstruction



[thetechjournal.com](http://thetechjournal.com)

# From 2D to 3D...

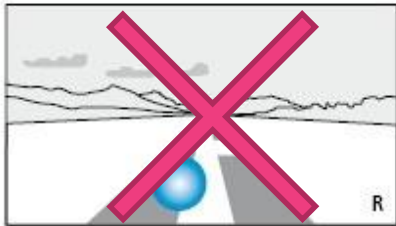
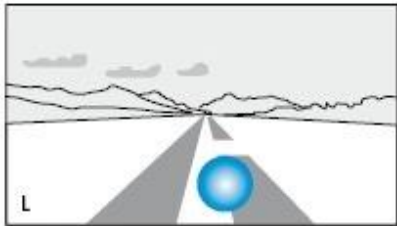
## 3D image reconstruction



*The image from the perspective of the left eye.*



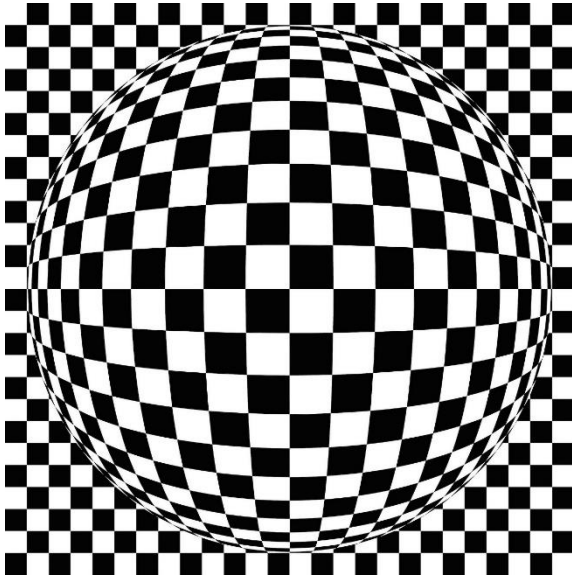
*The image from the perspective of the right eye.*



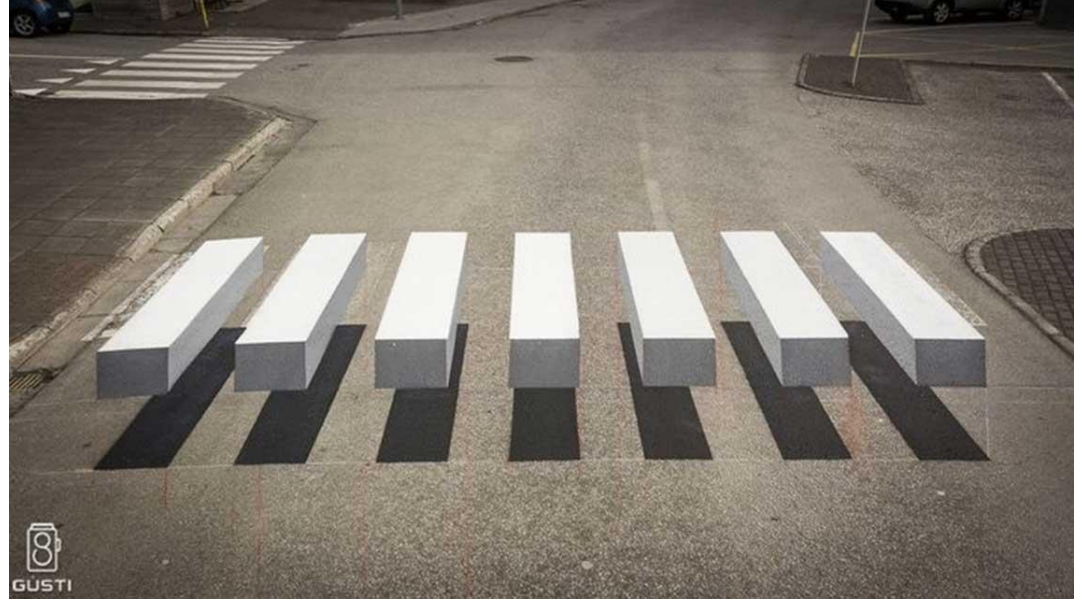
*Example Side-by-Side 3D-Format*

- Two eyes/cameras required

# From 2D to 3D...



pixabay.com



Gústi Productions

3D only with two images/eyes?

# From 2D to 3D...





# From 2D to 3D...

## 3D image reconstruction

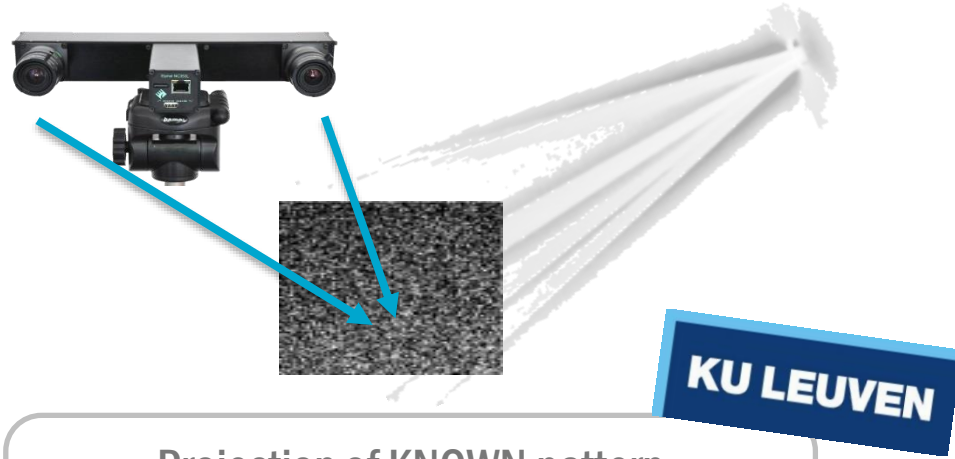


pixabay.com

- Two eyes/cameras required
- Otherwise: (good) illusion!
- Known pattern helps for 3D reconstruction!

# Application in aviation...

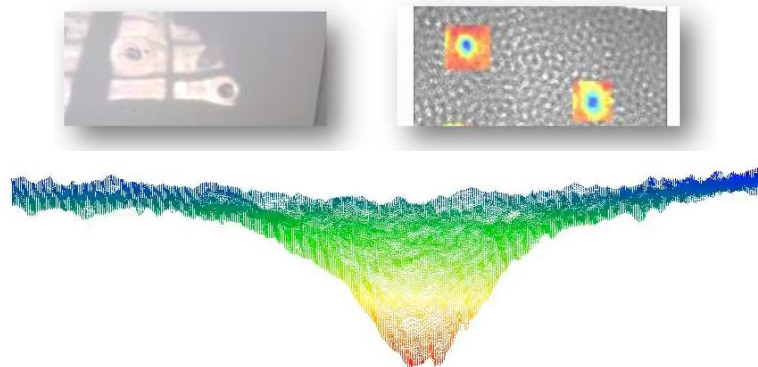
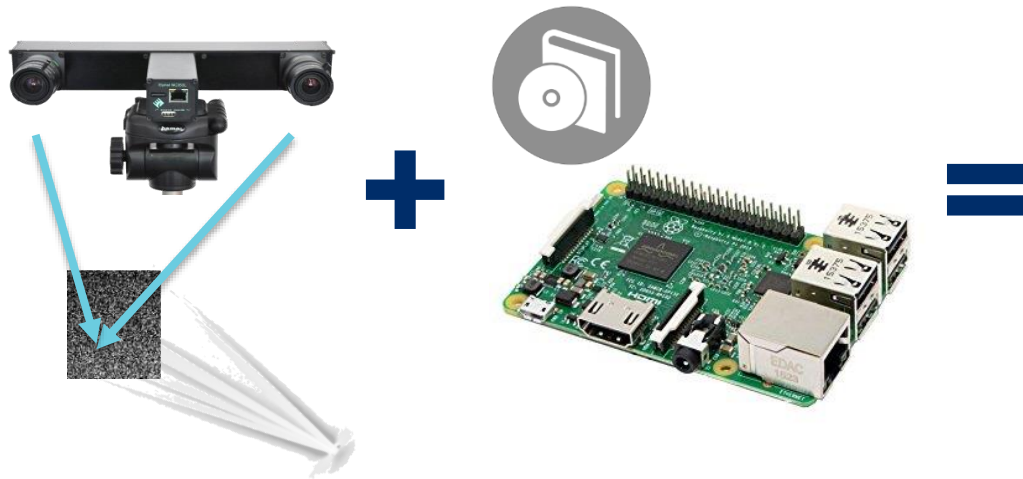
Speckle pattern and reference image?!



Projection of KNOWN pattern  
+ stereo camera  
+ reconstruction software

3D surface shape reconstruction

# Learn from nature...



# Advantage of DIC system



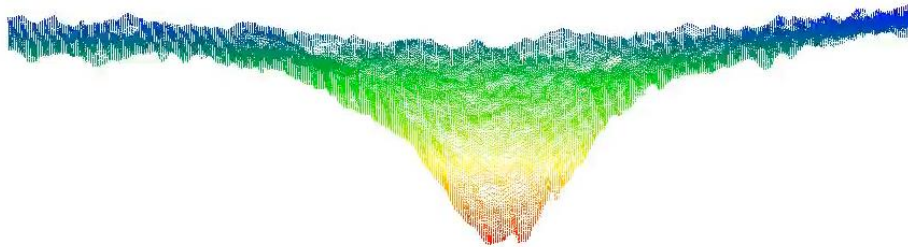
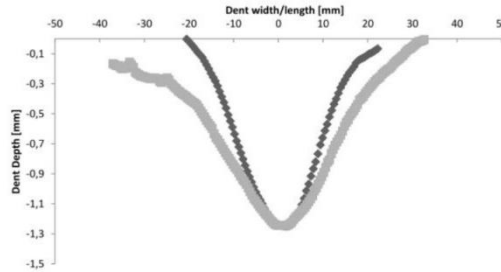
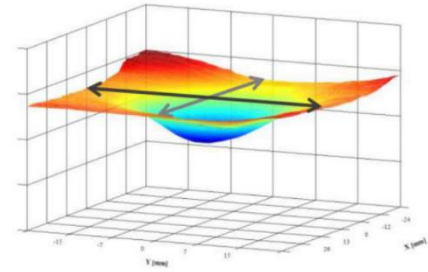
← 3840 PX →  
100 cm

Resolution of 3D reconstruction  
1/100 pixel → **0.02 mm**

- High accuracy
- Large field of view

# Advantage of DIC system

Full 3D surface reconstruction...



- High accuracy
- Large field of view



# Advantage of DIC system



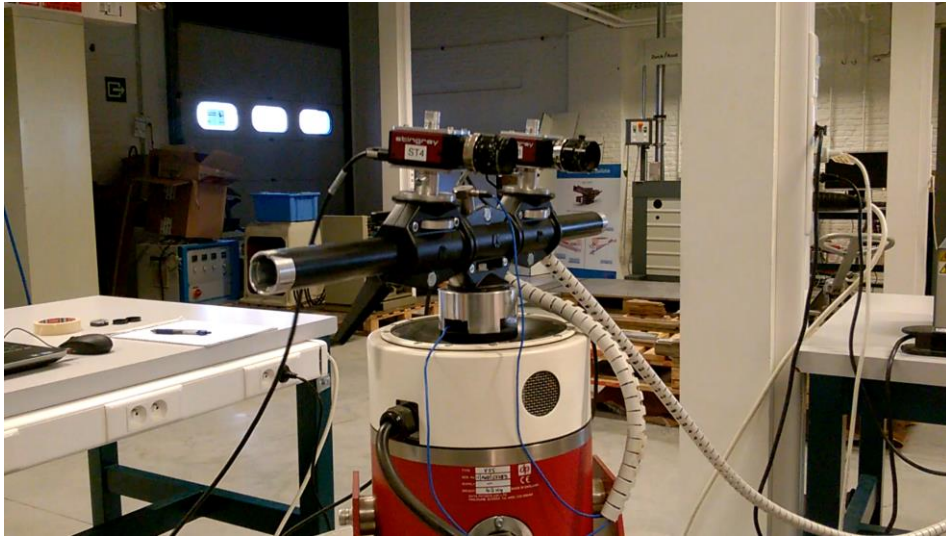
Case study : July 2015



- High accuracy
- Large field of view
- Easy to use

# Advantage of DIC system

Drone inspection possible?



- High accuracy
- Large field of view
- Easy to use
- Fast image capturing

Work performed by KU Leuven, Ruben Balcaen

# Advantage of DIC system



Drone inspection possible?

**Yes!**



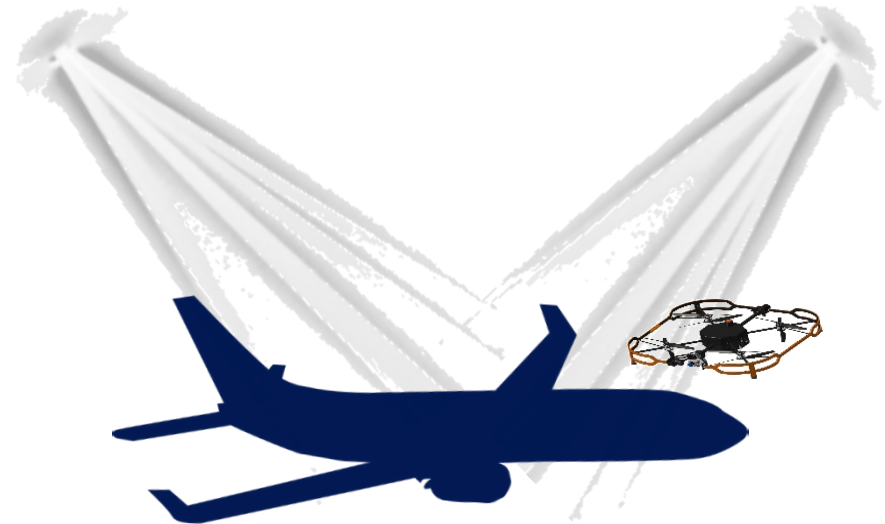
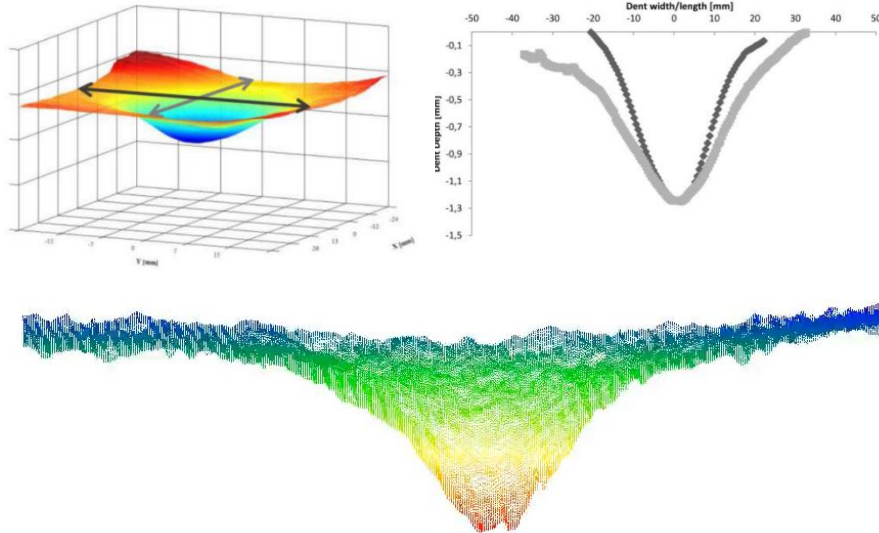
- High accuracy
- Large field of view
- Easy to use
- Fast image capturing



# “The future depends on what you do today...”

- Mahatma Gandhi

- Single dent inspection
- Not fully atomized
- Estimate depth, size and position
- Full A/C screening
- Zonal inspection
- Fully automated – with drone?!



# Thank you...



Michael Stamm  
NDT researcher &  
MSCA Fellow



Johan Reynaert  
Danny Vanspringel  
M&E department

**MatchID**  
Metrology beyond colors  
Pascal Lava



Helge Pfeiffer, Martine Wevers  
Dimitri Debruyne  
Ruben Balcaen



Marco Ricci  
Stefano Laureti  
Pietro Burrascano

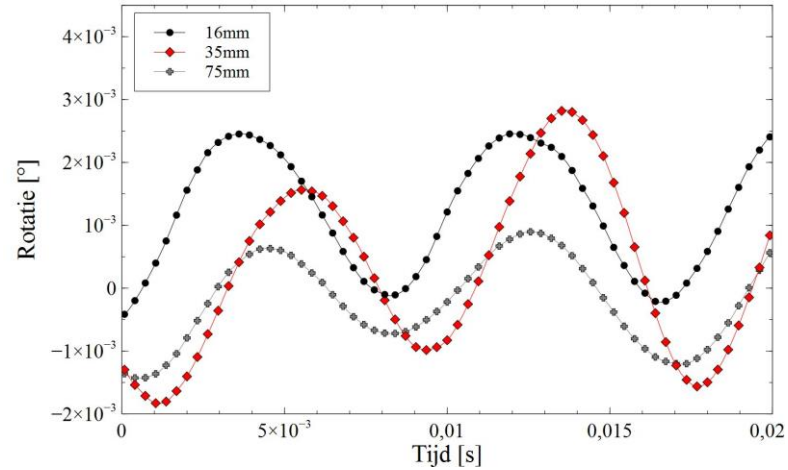
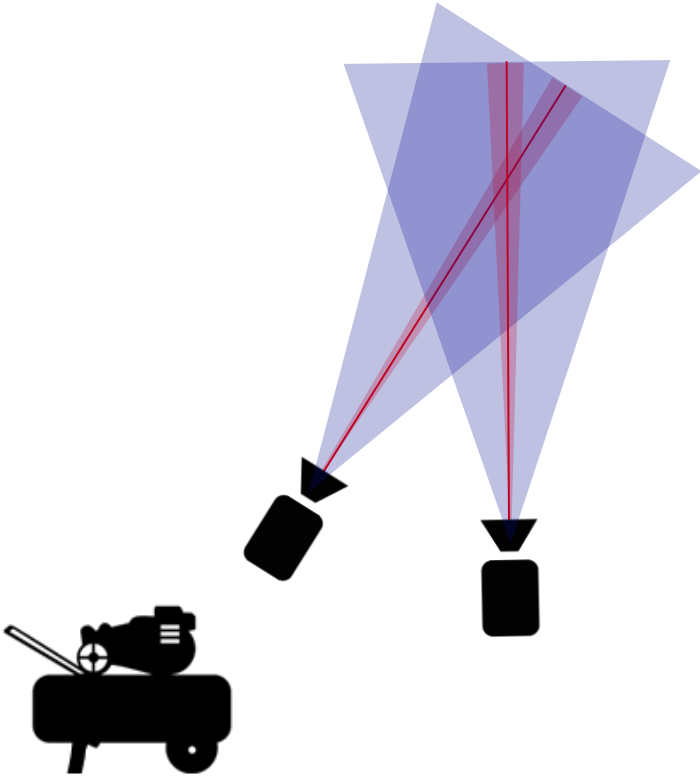


This project has received funding from  
the H2020-MSCA-ITN-2016 under grant  
agreement No 722134.

# ADD-ON

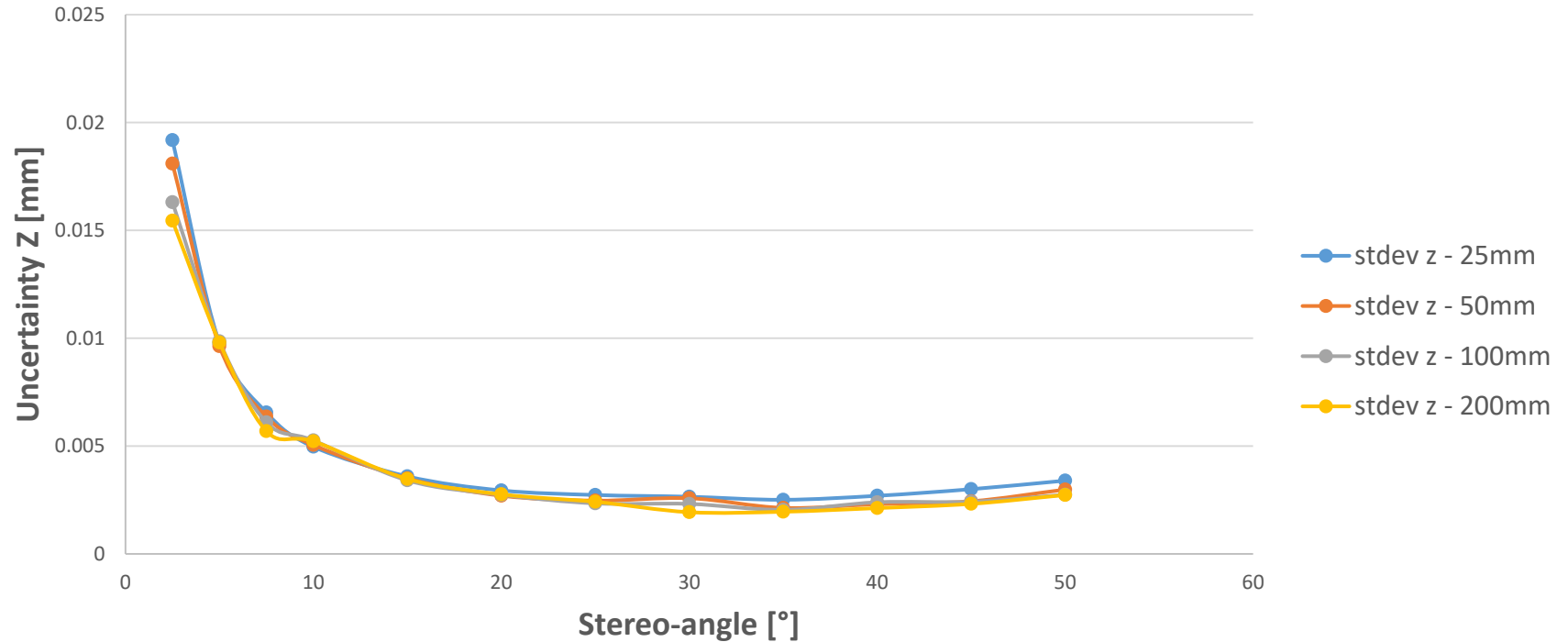


# VIBRATING CAMERA SYSTEM



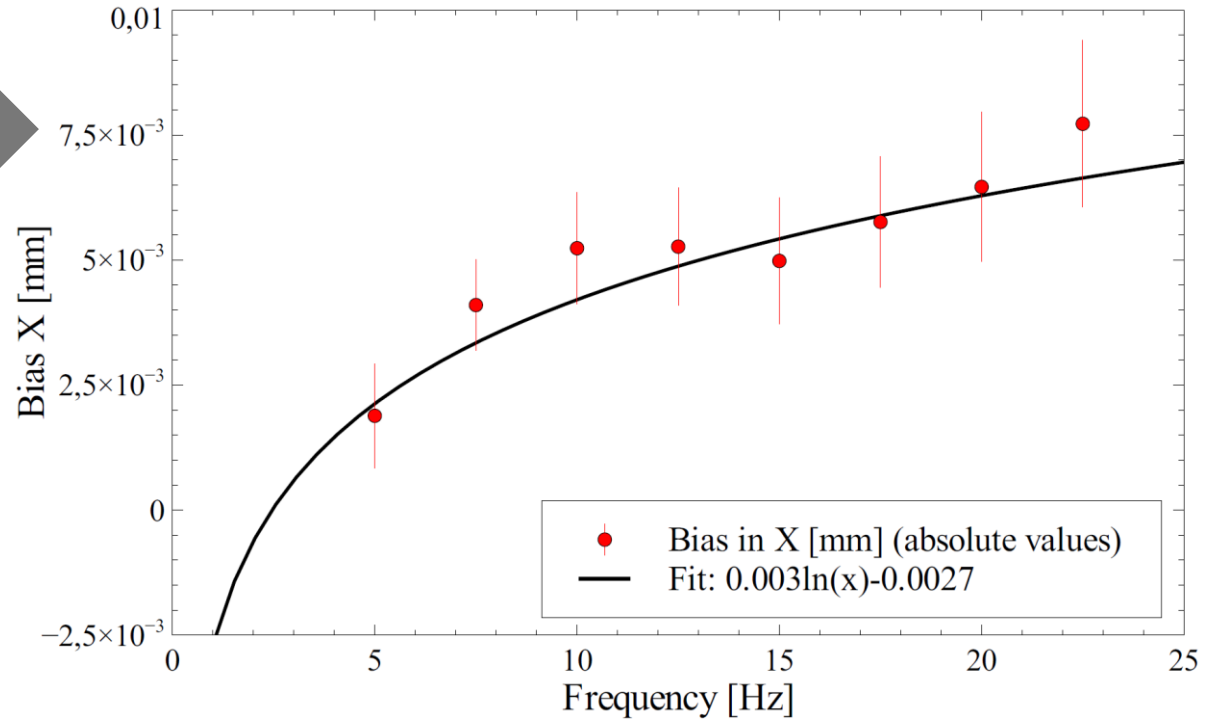
# CAMERA SYSTEM CONFIGURATION

## Uncertainty in Z [mm]



# VIBRATING CAMERA SYSTEM

**0.0075 mm**



# SINGLE DENT INSPECTION

