

3D optical scanning for fast & accurate hail damage assessment

NDT-dag 2014

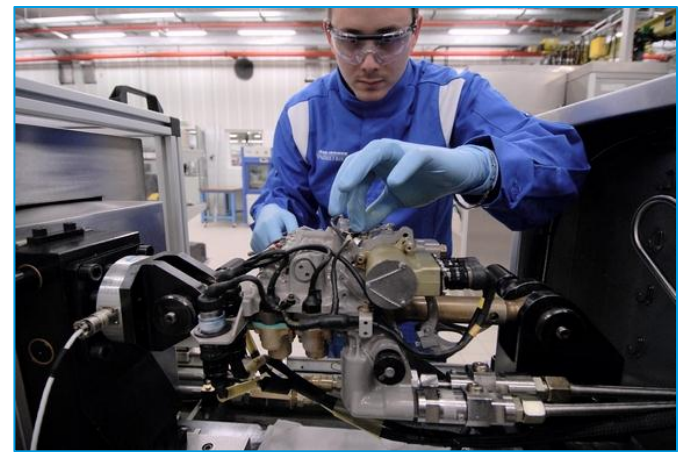
Mr. van Pascal
Mr. Hamer



Contents

- Background KLM Engineering & Maintenance
- Background on hail damage and hail damage assessment
- Research to use 3D optical scanning
- Implementation of 3D optical scanning for hail damage assessment

1. Background KLM Engineering & Maintenance



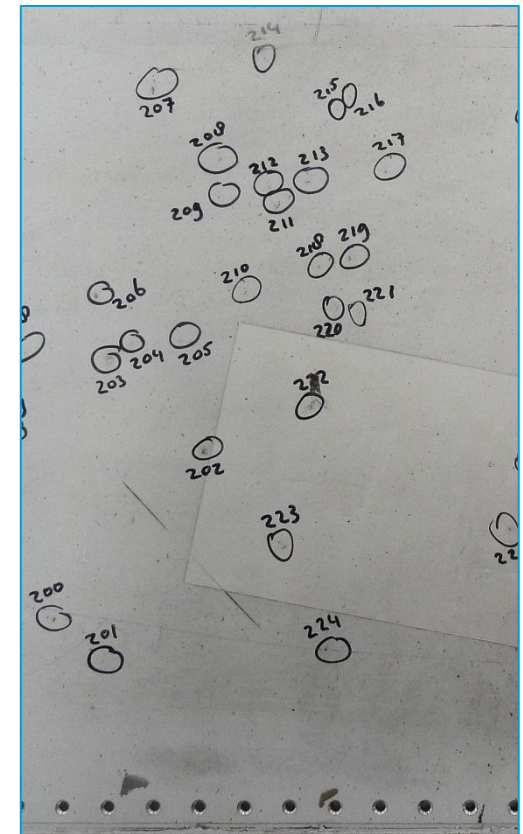
1. Background KLM Engineering & Maintenance

- Together with Air France Industries, KLM Engineering & Maintenance represents:
 - 14000 staff
 - 150 international customers and nearly 1300 aircraft supported
 - 5 main engineering and maintenance facilities
 - 600 000 parts in stock

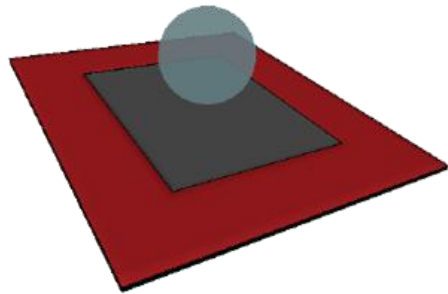
euros	December 31, 2012	December 31, 2013
Revenues (million)	3,134	3,280
Customers' revenues (million)	1,096	1,225
Operating (million)	145	159

2. Hail damage

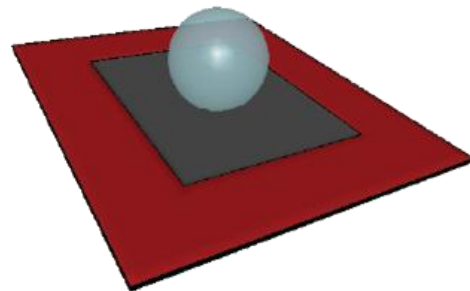
- On average, 4 times in a year a KLM aircraft is damaged by hail. Damage consists out of:
 - Dents
 - Delaminations
- Serviceably criteria are based on:
 - Dent size
 - Dent depth
 - Dents per square unit
 - Dent location



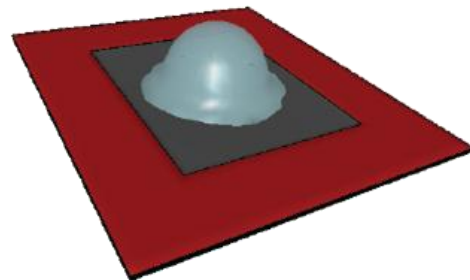
Hail impact simulation



0.00 ms

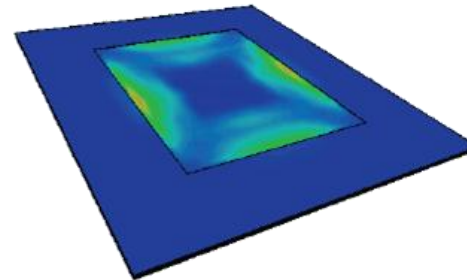
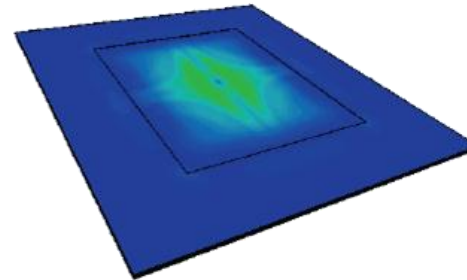
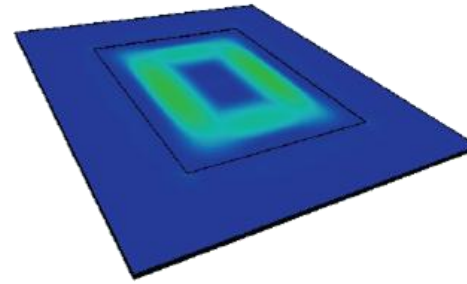


0.10 ms



0.25 ms

Example of first principal stress



3. Hail damage assessment

- Hail damage assessment is an extensive inspection
 - Hail damage is affecting large areas of the aircraft.
 - Damage assessment is performed manually and several administrative actions are required.



3. Hail damage assessment

- Currently, hail damage assessment takes about 3 to 5 hours per square meter.

	737	747	777	
Wing Span:	34	64	60	[meter]
Inspection length fuselage:	24	60	73	[meter]
Total inspection area :	50	100	120	[square meter]

4. Research to 3D scanning

- Lengthy inspection makes new technology very attractive.
- In 2012, plan was launched to investigate 3D scanning technologies to reduce inspection time.
- Research focused on:
 - Inspection accuracy
 - Inspection resolution
 - User interface and required software packages
 - Compatibility with KLM's 3D software packages
 - Mobility of system
 - Costs
 - Support OEM

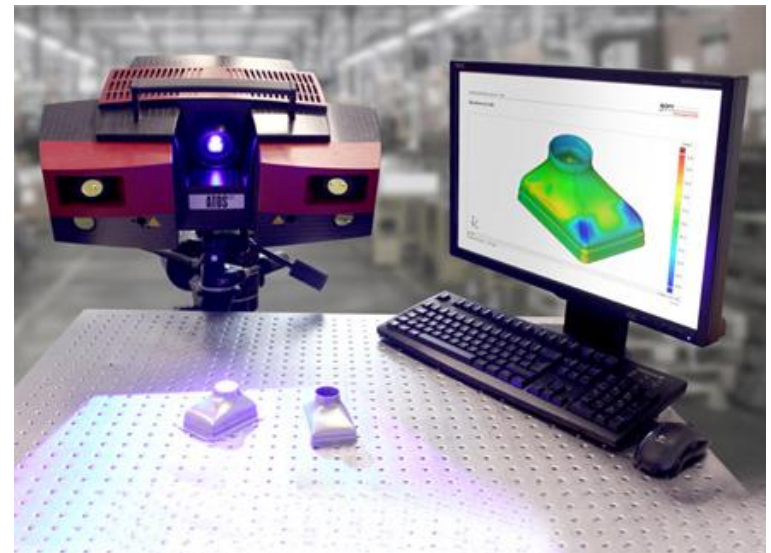
5. Fundamentals of 3D scanning

A 3D scanner is a device that analyzes a real-world object or environment to collect data on its shape

- Contact measuring machines such as Coordinate Measuring Machine (CMM)
- Non contact (optical) measurement machines such as laser scanners and white light scanners.



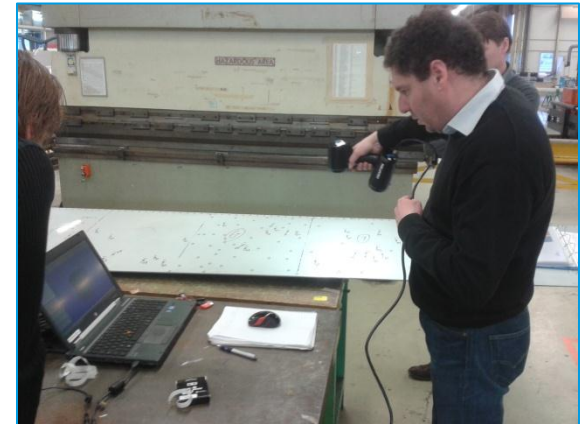
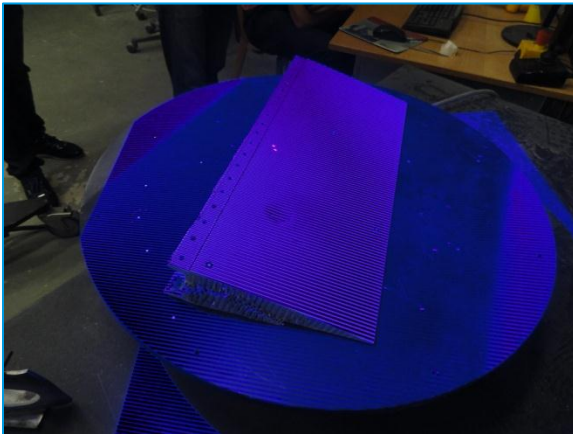
Tactile Measurements



Optical Measurements

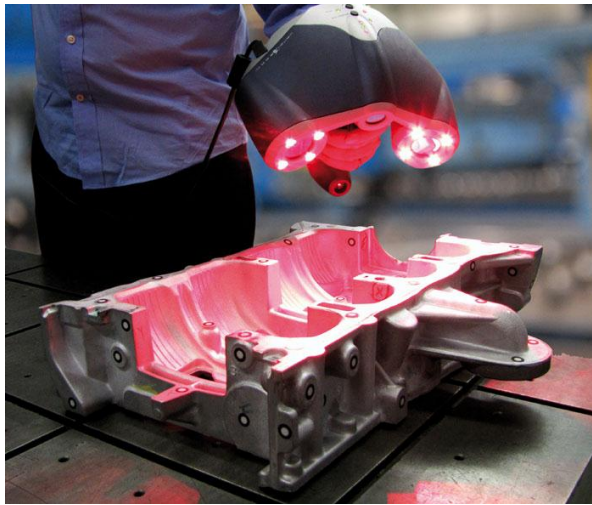
6. Research to 3D optical scanning for damage assessment

- Systems and technologies were tested from:
 - Blue light scanner – GOM
 - Hexagon
 - Laser scanning & white light scanning - Creaform 3D

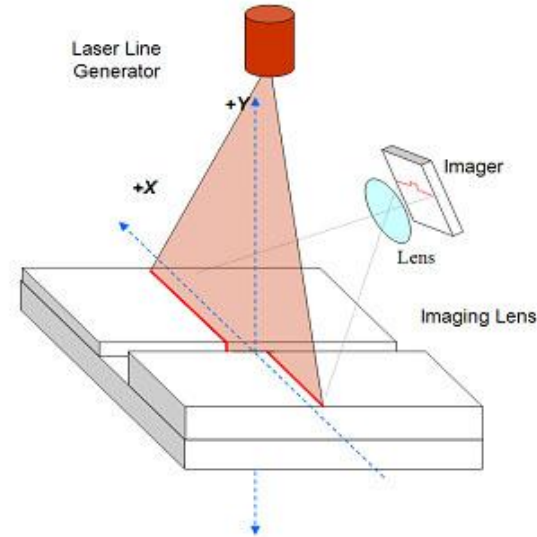


6. Research to 3D optical scanning for damage assessment

- Creaform handyscan – easier and mobile to use



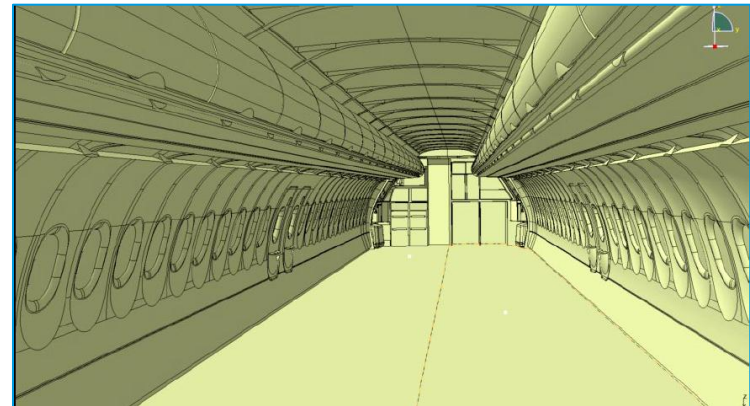
- LASER
- MEASUREMENT RATE
- RESOLUTION
- ACCURACY



- CLASS II (eye-safe)
- 18,000 measures/s
- 0.100 mm
- Up to 0.050 mm

6. Research to 3D optical scanning for damage assessment

- Boeing and Airbus had experience with Creaform. Also received more information that other airlines also started to experiment with systems from Creaform.
 - Lufthansa & AirFrance– interior redesign and modification



- Hawaiian airlines – corrosion inspection
- Qantas – Damage Assessment after uncontained engine failure

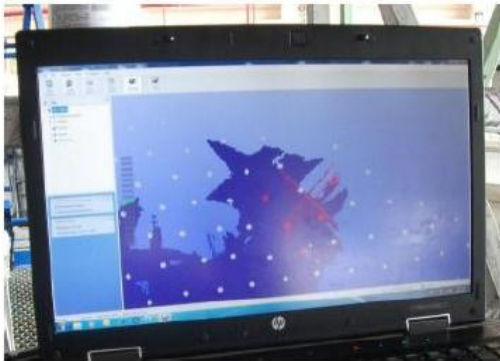
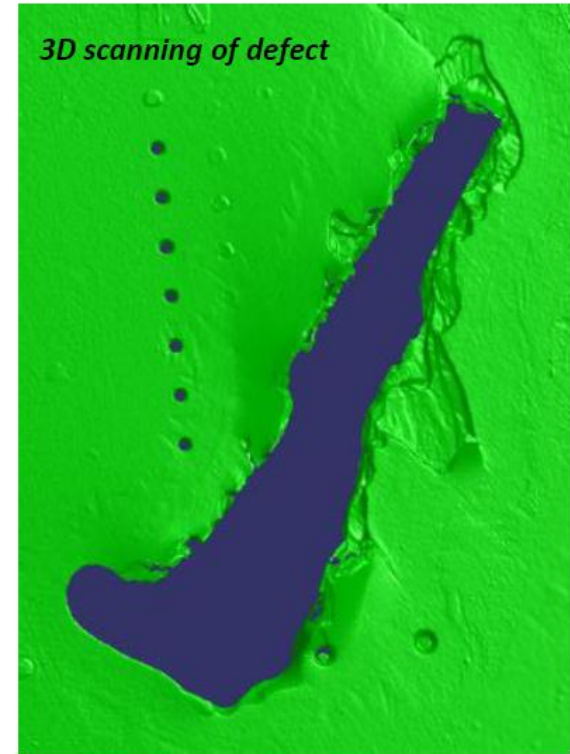
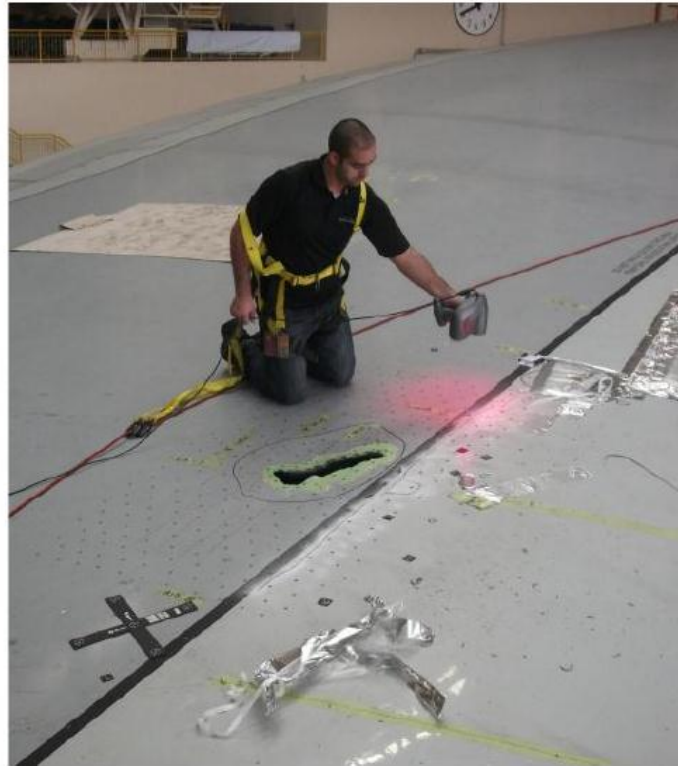
6. Research to 3D optical scanning for damage assessment - Qantas Case



Outer wing in-spar skin (*load carrying structure*) penetrated by engine debris.



6. Research to 3D optical scanning for damage assessment - Qantas Case



7. Implementation of 3D optical scanning for hail damage assessment

- One 3D handyscan from Creaform Systems is bought by KLM E&M in 2014 for hail damage assessment.
- Experience is built up with this technology and inspection strategies have to be redefined.
- 3D scanning inspection will be performed by engineering, however finally this technology will be handed over to production unit.

Conclusion

- KLM Engineering & Maintenance started experimenting with 3D optical scanning for damage assessment.



Any questions?

