

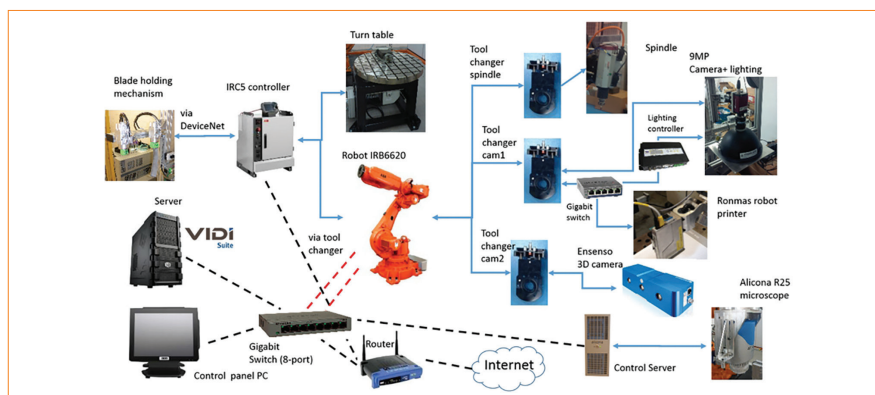
# 飛機噴射引擎部件表面點蝕自動分析系統

## Automated System for Surface Pitting Analysis on Airplane Jet Engine

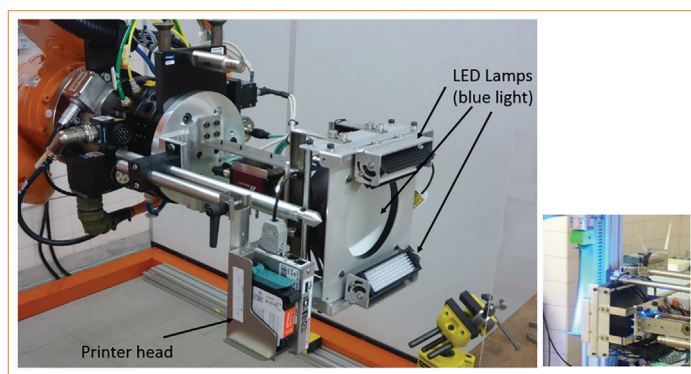
能夠識別及評估飛機噴射引擎部件表面缺陷的系統

A system that can identify and evaluate surface defects on airplane jet engine components

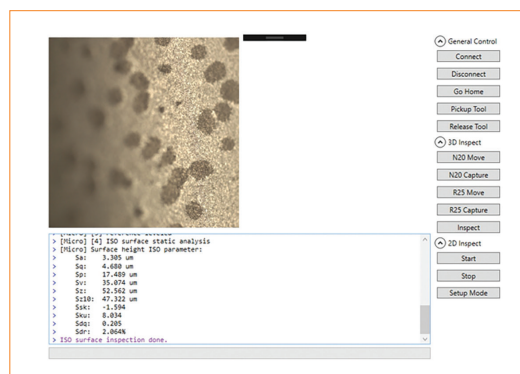
噴射引擎主要的部件形狀複雜、尺寸不定，因此，目前維修人員只能以肉眼檢查，觀察部件上是否有名為「點蝕」的表面缺陷。然而上述工序時，而人為錯誤亦會影響飛機維修的成本、質量和安全性。此自動分析系統結合機械人、圖像處理、深度學習和非破壞檢測等技術，利用機械人對部件進行掃描，從而識別和測量點蝕，在縮短檢測時間、提高質量的同時，又可以降低營運成本。



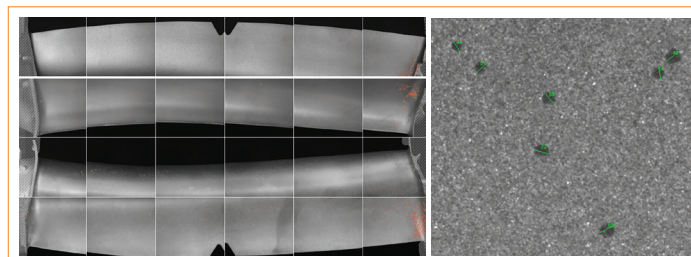
機器人單元的主要硬件  
The major hardware of the robot cell



相機和照明系統  
The camera and lighting system



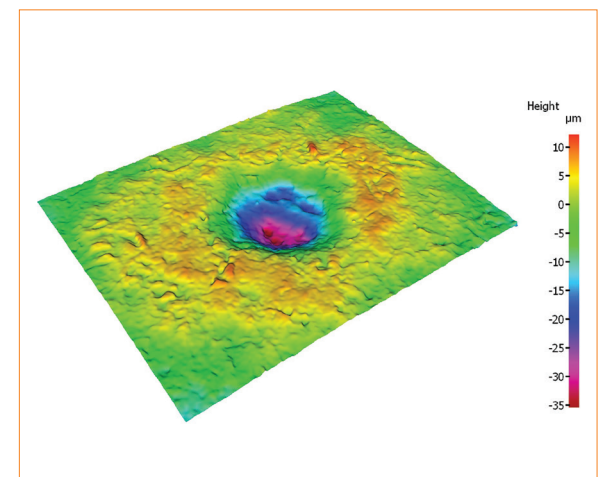
點蝕深度估計過程的輸出  
The output of the depth estimation procedure



深度學習點蝕檢測系統的輸出  
The outputs of the deep learning pitting detection system



Alcon傳感器獲取點蝕的三維模型  
Alcon sensor captures the 3D model of pitting



點蝕的三維模型(放大後)  
3D model of pitting (enlarged)

"Pitting" is a surface defect found on critical jet engine components of complex shapes and different sizes. It is currently detected by naked-eye inspection. Such task takes up significant man-hours, and embodies human errors which limit engine maintenance performance in terms of cost, time, quality, and safety. Combining robotics, image processing, deep learning, and non-destructive testing technologies, this automated system can identify and measure pitting. A robot is used to conduct inspection on engine components. The system shortens the inspection process, enhances the quality of work with more consistent workmanship and accuracy, and cuts down the operation costs.

### Principal Investigator

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### 特色與優點

- 採用深度學習辨認金屬表面的微小缺陷及其特徵
- 以微米級的精度自動獲取受查表面的三維信息和缺陷的尺寸

### 應用

- 自動檢測在噴射引擎葉片上的點蝕及分析翼型表面
- 檢測和測量噴射引擎機圓柱形部件的表面缺陷
- 搜索飛機機身和機翼上的任何異常的表面狀況（例如：雷擊痕跡）

### 獎項

第46屆瑞士日內瓦國際發明展 - 金獎 (2018年4月)

### Special Features and Advantages

- Employs deep learning to identify tiny defects on metal surface and extract defect features
- Captures the 3D information of inspected surface and the dimensions of individual defects automatically at micrometer scale

### Applications

- Detect pitting automatically and analyze airfoil surface of jet engine blades or vanes
- Detect and measure surface defects on cylindrical components of jet engine
- Search for any surface anomaly (e.g. lightning strike marks) on the airplane fuselage and wing

### Award

Gold Medal – 46th International Exhibition of Inventions of Geneva, Switzerland (Apr 2018)



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