Autonomous systems and Hangar of the Future

Luca Zanotti Fragonara
Centre for Autonomous and Cyberphysical Systems

17th October 2019

www.cranfield.ac.uk
Autonomous Systems

- Perception: detection with deep learning models, multi-target tracking and data association.
- Sensor Fusion architectures (distributed architectures).
- Task allocation.
ShufflePointNet: An Efficient Neural Network for Point Cloud Analysis via Group Convolutions

- ShufflePointNet is an efficient way to process point-cloud data
- Uses the concept of channel shuffle and shuffle layer
- A state-of-the-art deep neural network capable of reaching high-level accuracy for segmentation and classification
- Efficient computational performance

Fig. 3. ShufflePointNet architecture: The architecture use PointNet++ as backbone, and it contains classification structure (top branch) and semantic segmentation structure (bottom branch) for point cloud. In detail, \( N, F \) indicates the number of input points, and corresponding feature channels respectively. \( k \) is the number of the neighbors. Besides, the number in the brace {} indicates the MLP filters.
Hangar of the future

- Automated inspections
- Sensor fusion
- Data analytics
- Predictive maintenance

**UAV inspection (using RGB or IRT cameras)**

**Robo-inspections (Ultrasonic + IRT)**

![Robo-inspections Diagram](image)
Using data analyse patterns

Pattern Analysis
Identify unusual patterns of fault frequency across the fleet aircraft → Early warning for potential issue

<Concept of Pattern Analysis>

<Analysis Results>

<Overall Process>
Using data to predict failures

Correlation Analysis
Identify correlated fault types in term of occurrence pattern → High-level fault prognosis

Data Mining
Machine Learning
Density-Based Clustering

Knowledge Based System
Decision Trees
Self-Organizing Map

K-means algorithm
Support Vector Machine
Hill Climbing Algorithm

DATA ANALYTICS OUTCOMES
Pattern Analysis

<Analysis Results>
Identify unusual patterns of...

<Concept of Correlation Analysis>

<Overall Process>

<Analysis Results>

Preprocessing
Feature Generation
Methodology
Outputs (Information)

Raw Data (Fault Record Data)
Data Cleaning
Jaccard coefficient
Identification of correlated fault types