Università degli Studi di Padova

Dipartimento di Ingegneria dell'Informazione

Intelligent Autonomous Systems Lab

SPIRIT

A software framework for the efficient setup of industrial inspection robots

EU Horizon 2020 Research and Innovation Program No. 779431

http://spirit-h2020.eu/

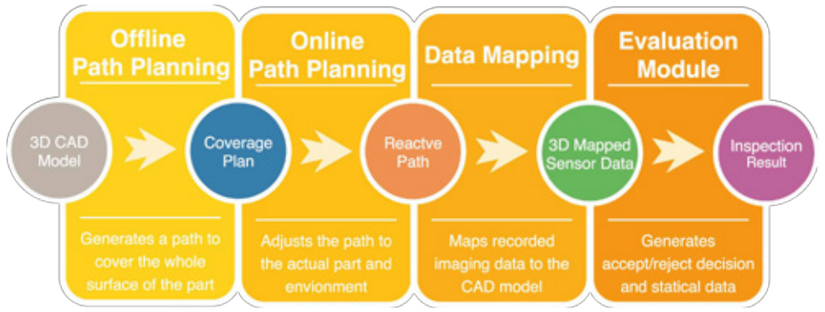
Introduction

The SPIRIT project aims to develop a general inspection robot framework that takes the step from programming of complex inspection tasks to configuring such tasks. This includes inspection tasks that use image-based sensors and require a continuous motion to fully scan a part's surface and substantially reduce the engineering costs when setting up inspection robots in industrial environments.

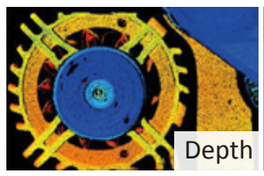
Objectives

The project aims to develop:

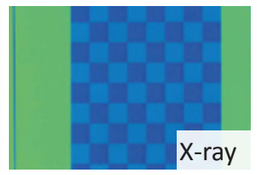
- Fully automatic offline path planning that ensures full coverage of the areas to be inspected on the part
- Reactive online path planning that is able to automatically adjust to small changes of the part and the environment
- Seamless mapping of imaging data to a 3D model of the part

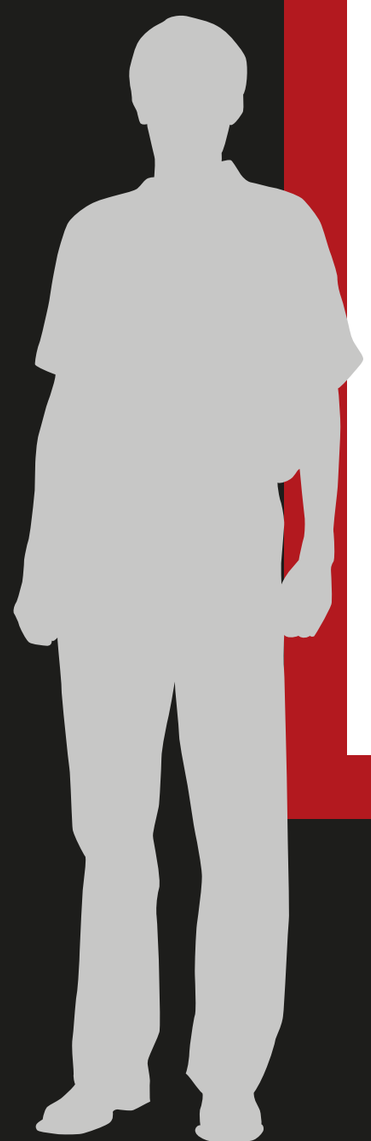


All the components are designed to be "general" methods which can deal with different camera models (RGB-D, Infrared, and X-ray) so that the system can be configured for any kind of imaging sensor suitable for any inspection task.


Depth


Infrared


X-ray



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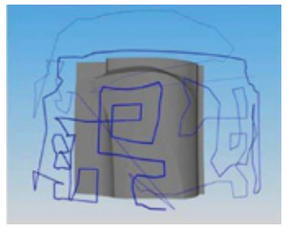
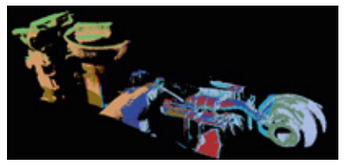
Online/Offline Path Planning



The fully automatic offline path planner handles the model-based automatic coverage planning for complex parts and various image-based inspection processes as well as the automatic robot program generation. It will include a generic interface to allow the easy exchange of process models (for different inspection technologies), of the CAD model of the part (for a different type of product to be inspected) or of the work-cell model (for a different kinematic structure).

The reactive online path planner adjusts the offline generated path to deal with small deviations between the actual appearance of the part and its CAD model and provides the backbone for the real-time execution of the actual inspection process, such as data acquisition and robot motion control.

Objectives



The mapping module re-projects 2D sensor data onto the corresponding part on the CAD model. This process gets rid of artifacts on the images caused by the 3D shape of the part and the sensor distortion and seamlessly merges the images into one patch on the CAD model.

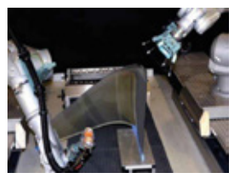
The generated 3D image mapped part model is passed to the evaluation module which makes the accept/reject decision and collects statistical data of the operation.

Examples

Assembly inspection with 3D sensing

During the assembly of engines, the presence and the type of several components need to be verified. A robotic system will adaptively position a 3D sensor to detect and verify the components.

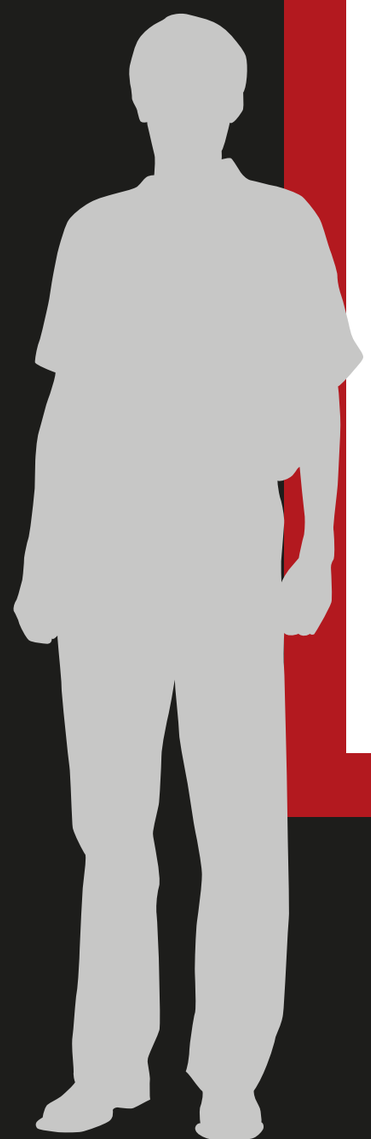
X-ray inspection of composite parts



For structural aircraft components, X-Ray inspection is used to check for any changes in the material. The framework can deal with the different imaging sensor with a small effort on the task configuration.

Thermographic crack-detection on forged parts

A thermographic inspection process is used to detect cracks on forged parts.



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