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Synchronism system for generating ultrasonic images of complex geometry pieces using industrial robots

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ABSTRACT

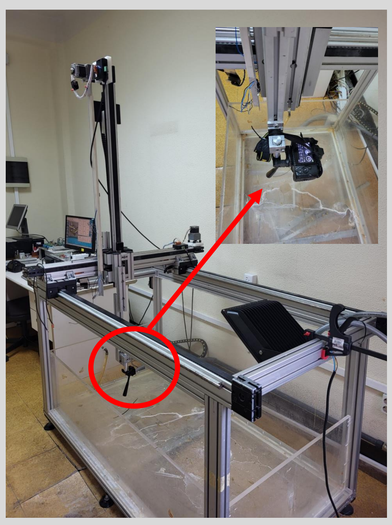
This paper presents a synchronism system that has been designed to facilitate the generation of ultrasonic images of pieces with complex geometry through the use of industrial robots. Automatic ultrasonic inspection of complex parts remains one of the most difficult challenges according to the specific and increasingly exigent demands of the markets. The closed configuration of these complex robotic arms makes it difficult to maintain adequate synchronism between the movement of the robot and the acquisition of the data, making it difficult to generate ultrasonic images consistent with the geometry of the part. This is a serious problem in the inspection of aerospace components where high quality is necessary to assess the condition of the inspected component.

In this paper, we present an autonomous independent external system that provides control signals to synchronize the ultrasound system with the robot trajectories without needing to access its position in real time. A methodology to obtain the timing pattern for a given part inspected with a given robotic system will also be presented here.

PROPOSAL METHODOLOGY

Visual inspection High-speed camera → Photo/Extraction frames from videos → Processing to photogrammetric software → Location of the robotic arm

Experimental tests at ITEFI Laboratory



Automatic Cartesian system method

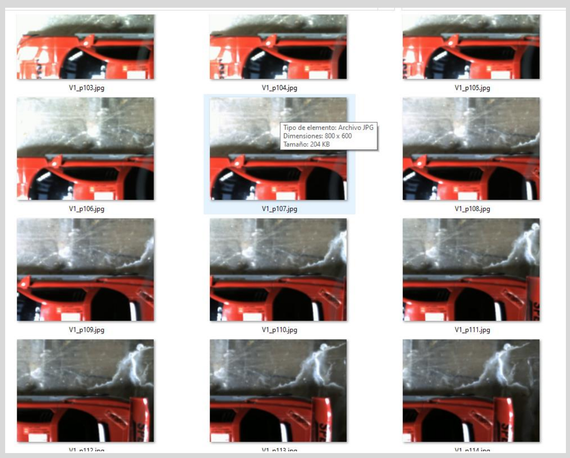
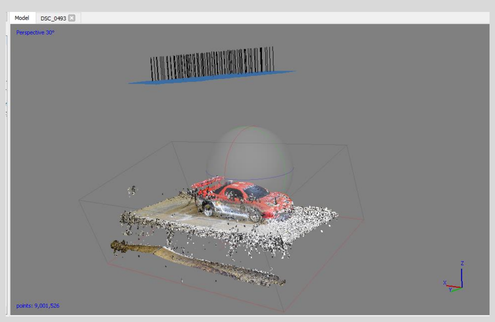
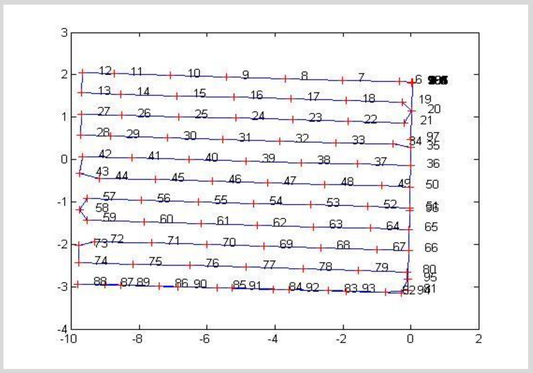


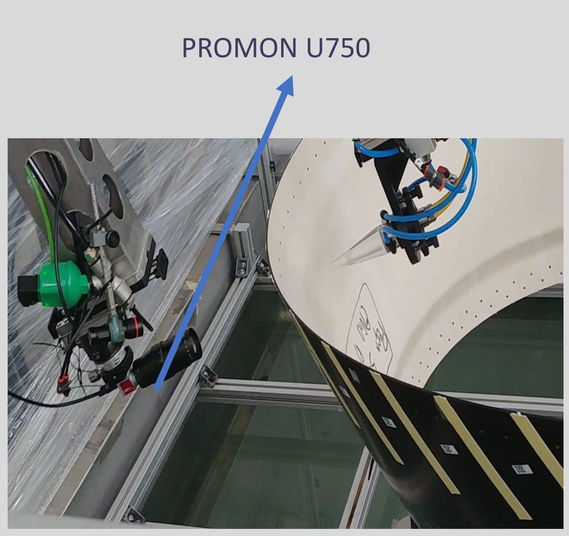
Photo sequence



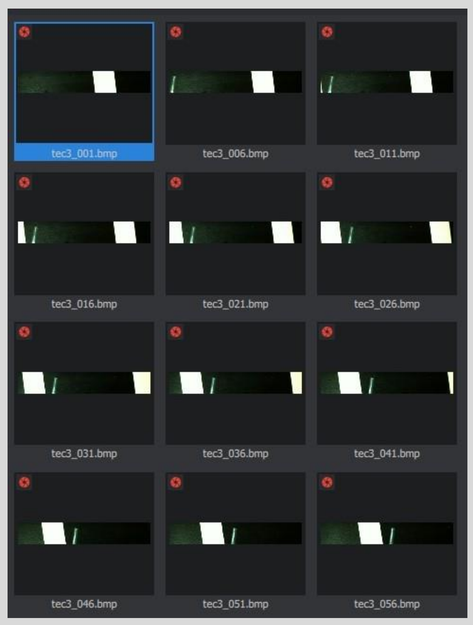


Results using an industrial robot at ITEFI

Experimental tests at TECNITEST



Robotic arm system method



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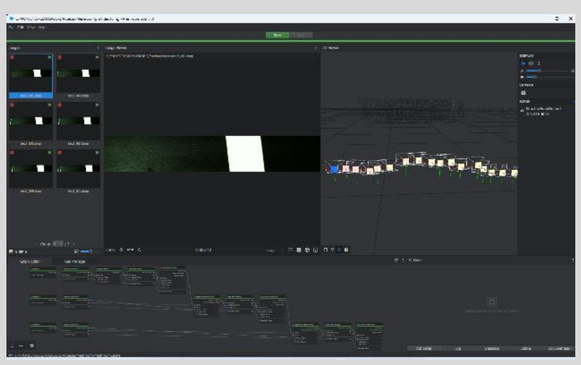

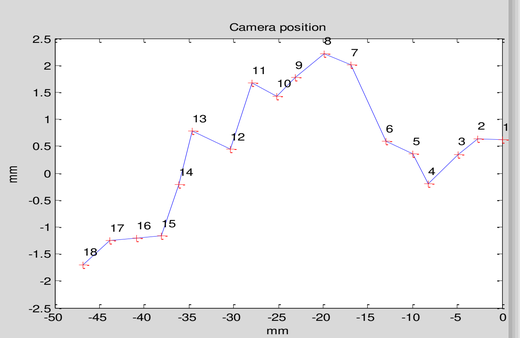

Results using an industrial robot at Tecnitest

CONCLUSIONS

After seeing the results of the methodology previously presented, it has been demonstrated that it is possible to apply photogrammetric techniques in order to precisely indicate the exact location of the robotic arm. A relation is obtained to each of the video frames or pictures taken during its sweep or trajectory, as well as the inclination. The main drawback of this method is that it requires adapting the robotic system to be able to install the camera and lighting system that are needed for the calibration sweep. But it is a viable alternative if there are circumstances in which self-calibration with an ultrasound system itself does not produce satisfactory results. To sum up, this new methodology can be easily applied to the commercial industrial robots when performing non-destructive testing inspections in order to ensure the synchronism between the movement of the robot and the acquisition of the data.

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