

Implementation of a human-machine-interaction control system in a human-robot-collaborative riveting process in aircraft assembly**Tobias Masiak, Rainer Müller and Matthias Vette-Steinkamp**

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Assembly processes in aircraft production are difficult to automate due to technical risks. Examples of such technical challenges are small batch sizes, large product dimensions and limited work space. Full automation of complex processes is expensive as it requires much effort with respect to service and maintenance. A semi-automated process, utilizing human-robot-collaboration, is the most effective approach for optimizing aircraft production in relation to aircraft section assembly. In the assembly process of the aft section of aircrafts, the pressure bulk head is assembled with the section barrel using hundreds of rivets. This assembly process is a non-ergonomic and demanding task in which two people are working together collaboratively. Working conditions can be improved through collaboration between the operator and the robot system. The approach is based on the process requirements as well as dynamic and skill based task sharing between the operator and the robot. This is demonstrated by positioning a robot within section 19. The robot's task is to position the anvil tool, while the operator performs the more complex task of inserting the rivet and operating the riveting tool. An intuitive operating is implemented to increase operator acceptance and to enable interaction with production equipment. Within the framework of natural and intuitive human machine interaction, smart devices are integrated to control process specific production equipment. Graphical user interfaces in smart phones or smart watches and the integration of mixed reality technology offers new possibilities for visualization and assistance. The developed systems allow intuitive configuration and operation of the station using an open control concept and dynamic task sharing. The operator is therefore supported with a collaborative robot in combination with additional assistance systems in order to improve production quality and ergonomics during the riveting process. The results are part of the EU's Horizon 2020 research and innovation programme in the four by three projects at ZeMA.



Figure 1: Collaborative riveting process between humans and robots at ZeMA.

Recent Publications

1. Rainer Müller, Matthias Vette, Aaron Geenen and Tobias Masiak (2017) Improving working conditions in aircraft productions using human-robot-collaboration in a collaborative riveting process. Aero Tech Congress & Exhibition DOI: 10.4271/2017-01-2096.

2. Rainer Müller, Matthias Vette, Steinkamp, Aaron Geenen, Tobias Masiak and Ali Kanso (2017) Methodology for design of mechatronic robotic manipulators based on suitability for modern application scenarios. International Federation of Automatic Control - PapersOnLine 50(1):12727-12733.

Biography

Tobias Masiak is a Research Assistant at ZeMA in human robot collaboration in the areas of aircraft production, process development as well as human machine interaction in the frame of automation and handling devices. Moreover, he is a Managing Director of a marketing agency and runs a startup as well.

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