Assembly Planning and SIMulation of an Aircraft Final Assembly Line

Sprawozdania

Informacje na temat projektu

SIMFAL

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Strona internetowa projektu

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Periodic Reporting for period 2 - SIMFAL (Assembly Planning and SIMulation of an Aircraft Final Assembly Line)

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Podsumowanie kontekstu i ogólnych celów projektu

The main objective of SIMFAL project is to analyse, plan and optimize automated assembly tasks of cabin and cargo interior parts with a coexistence of human workforce facilitating working places where workers are collaborating with automation systems and enhancing the total system (human and automation). To do that, the project will set up a simulation environment based on VR and AR to display and evaluate alternative process scenarios. On one hand, a VR environment is developed for simulating the assembly of the interior of an aircraft. The results will feed an AR system. This tool is used for worker assistance during the assembly process visualizing/monitoring actual information in real-time. These two tools together enable to evaluate different assembly alternatives, choosing the best one in terms of productivity and health and safety of the worker (ergonomic conditions). As a conclusion of the project, we have a very flexible and powerful interactive VR simulator with which it is possible to generate different alternatives of scenarios to an assembly process changing the level of automation, human-robot collaboration, number of robots, etc. After, a multivariable analysis can be done in order to evaluate the alternatives with different KPIs like timing, cost, ergonomics, investments and ROI. A total of 23 basic scenarios and 81 whole aircraft scenarios have been simulated and evaluated. In summary, the VR simulator is a very robust platform for “try-evaluate-decide” in terms of process decisions. Besides, we have developed a Digital Twin demonstrator to check real processes. This is possible thanks to a robust communications architecture developed between real robots of the process and the virtual ones in the Digital Twin. This demonstrator enables users to see virtually every single robots and parts movements as well as a general Dashboard with process/tasks information. An Augmented Reality Tool has also been integrated to the Digital Twin so that the system can guide workers in human-robot collaborative tasks. In the future, this demonstrator won’t be only used to monitor the process but also to control/change parameters of the process in real time.

Prace wykonane od początku projektu do końca okresu sprawozdawczego oraz najważniejsze dotychczasowe rezultaty

Nowadays, many processes of aircraft manufacturing, like cabin and cargo elements assembly, are still mainly done manually; also, many of the assembly operations are currently performed under non-ergonomic conditions and the process chains are complex and insufficiently transparent. The main idea of SIMFAL project is to detect how these tasks are currently performing, how they will perform with automation in virtual reality, compare the scenarios and improve the process.
The main objective of SIMFAL project has been to analyse, plan and optimize automated assembly tasks of cabin and cargo interior parts with a coexistence of human workforce facilitating working places where workers are collaborating with automation systems and enhancing the total system (human and automation). To do that, the project has developed a complete and interactive simulation environment based on VR and AR to display and evaluate alternative process scenarios. On one hand, a VR environment is developed for simulating the assembly of the interior of an aircraft. The results will feed an AR system. This tool is used for worker assistance during the assembly process visualizing/monitoring actual information in real-time. These two tools together enable to evaluate different assembly alternatives, choosing the best one in terms of productivity and health and safety of the worker (ergonomic conditions).
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which it is possible to generate different alternatives of scenarios to an assembly process changing the level of automation, human-robot collaboration, number of robots, etc. After, a multivariable analysis can be done in order to evaluate the alternatives with different KPIs (Key Performance Indicators) like timing, cost, ergonomics, investments and ROI. A total of 23 basic scenarios and 81 whole aircraft scenarios have been simulated and evaluated.
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The summary of the main results of the project is the following:

1. Flexible and Interactive Virtual Simulator
a. A very flexible VR environment to simulate different scenarios (full-automated and human-robot collaborative)
b. Task manager and agents system to monitor, interpretate and evaluate tasks
c. Motion capture system to evaluate ergonomics
d. Robust platform for “try-evaluate-decide” in terms of process decisions

2. Evaluation of productivity
a. Acquisition of different KPIs (timing, cost, ergonomics,…) for evaluating each process
b. Comparison of simulated scenarios vs traditional (Airbus) process
c. Multivariable statistical analysis
d. 23 scenarios of independent parts and 81 whole aircraft scenarios

3. Digital Twin demonstrator
a. The Simulator can also work as a Digital Twin to check real process with a communication with the real devices
b. The user can see virtually every single robots and parts movements
c. General dashboard to see process/task information
d. Integration with an Augmented Reality Tool to guide workers in human-robot collaborative tasks
e. It can be used as a process remote monitoring

Future work: not only monitoring but also control/change the process in real time

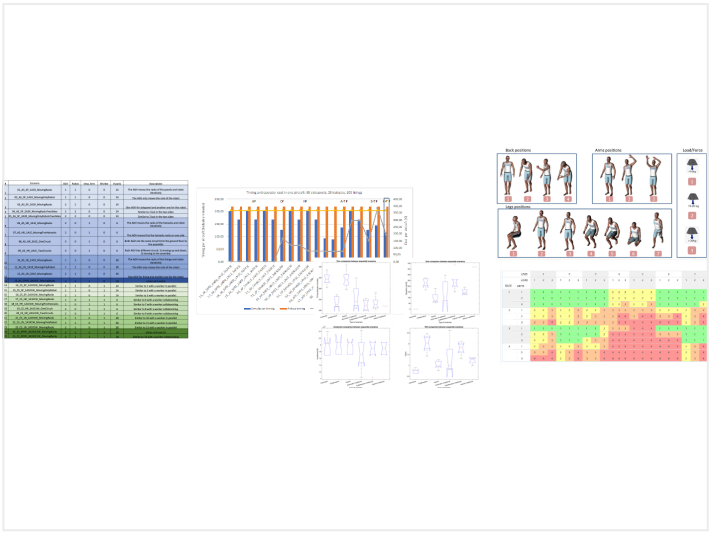
Innowacyjność oraz oczekiwany potencjalny wpływ (w tym dotychczasowe znaczenie społeczno-gospodarcze i szersze implikacje społeczne projektu)

The developed VR simulator is a powerful tool to define scenarios, try and evaluate them without the needs of setting-up, buying devices, personal costs, timing, etc. The VR simulator software allows

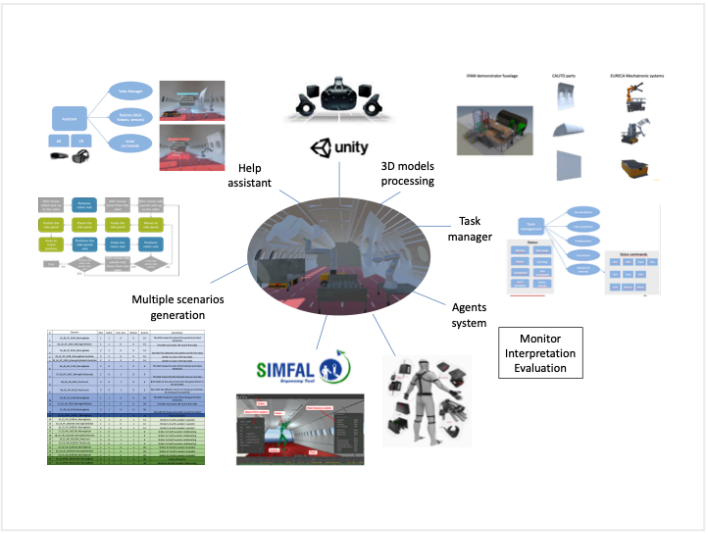
evaluating and visualising different scenarios of human-robot coexistence (changing human-robot workload, number of robots and tasks order), both in normal circumstances and in unpredicted situations. Although sudden changes occur in the simulation, the software is able to plan and adjust quickly human-robot co-operation.

SIMFAL results proof that the actual (traditional) process could be improved in terms of speed, cost-efficient and ergonomics. At the end of the Project, 81 different scenarios have been simulated for a whole aircraft cabin and cargo assembly. Depending on the parameter to be optimized (time, cost, ROI, ergonomics), a different scenario can be chosen. One of the most important impacts achieved by SIMFAL is the ergonomics. As it has been one of the KPIs selected for the simulations, it is easy to choose the scenarios with the lower value in ergonomics, improving in this way working conditions and health of workers.

On the other hand, the benefits of the second prototype developed into the project (the Digital Twin) are the possibility of monitoring and controlling in real time an industrial process in a remote way and guiding workers using AR. In the future, this demonstrator won't be only used to monitor the process but also to control/change parameters of the process in real time.



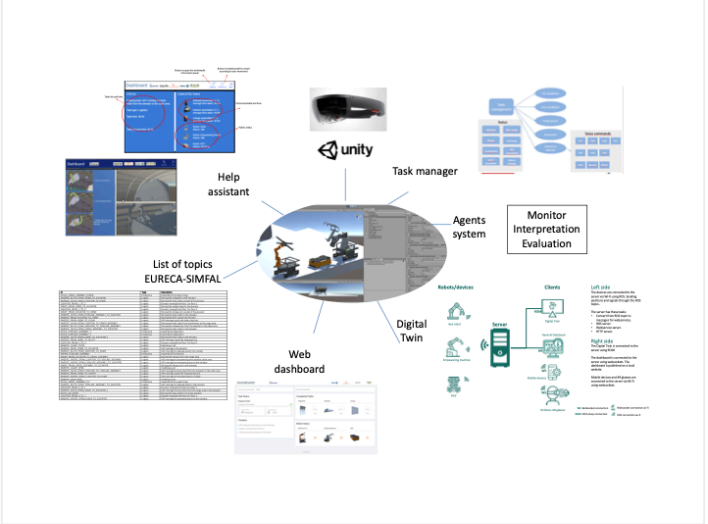
Evaluation of Productivity



VR Simulator

SIMFAL

LOGO SIMFAL



Digital Twin and AR Tool

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