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Proposed Framework Using Reinforcement Learning for Automated Cable Design, Routing, And Robotic Installation on Launch Vehicles And Spacecraft

Cable design on launch vehicles and spacecraft is complex, costly, and time intensive. Design is dictated by the components connected, length between components, and restrictions between components (physical, heat, vibration, angles, etc.).Given that cables are designed almost entirely by constraints, a reinforcement learning approach may provide optimum, automated design and manufacture capability.

The proposed framework to achieve this includes a number of critical elements. First, a strong digital thread must be in place that connects all relevant data from the vehicle requirements, component requirements, physical attributes of the cabling, scoring map of the vehicle (for suitability of routing/placement), and the specific setup of the manufacturing cell. Next, an adequate simulation environment must be developed in order to replicate the physical properties of the material and components, the manufacturing cell placement and physics, and the capabilities/limitation of the assembly robot. Then, there must exist a proper reinforcement learning algorithm that can be trained in the simulated environment. This includes determining sufficient intermediate rewards to enforce ideal behaviors of the robotic arm, which will learn the ideal placement and routing of each cable.Finally, the trained model must be able to accurately translate into the physical robotic arm, with sensors comparable to the simulated environment. By approaching cable design in this manner, it is possible for the reinforcement learning approach to inform the actual design of each cable, saving the process six months to a year of engineering/manufacturing lead time.

This presentation will show how this proposed framework is possible, work that has been achieved to date, and why this innovation is necessary to accomplish the EU goal of a zero emission aerospace industry by 2050.

Keywords: AI, Reinforcement Learning, Robotics, VR, Spacecraft, Aerospace

Biography:

Prof. Nathan Eskue is an aerospace engineering professor at TU Delft, specializing in AI, robotics, manufacturing, project/business management, and rapid iteration prototyping. He holds degrees in business information systems, marketing, operations management, an MBA, and a masters of Data Science from Columbia University. Nathan has spoken at over 60 international conferences on AI, aerospace/defense, quantum, and other technical topics. He's worked for NASA, Raytheon, Northrop Grumman, and other aerospace organizations for over twenty years, with experience in product development, project management, supply chain, manufacturing, and AI architecture.

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