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Abstract

Multiple Material Deposition (MMD) system for applications to hazardous environments and disaster scenarios

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Abstract:

The largest risk in the aftermath of environmental disasters is typically the damage that has occurred to structures. A material extrusion device capable of traversing highly irregular terrain, able to operate in hazardous or difficult to reach locations, and repair damage would largely mitigate many of the risks for survivors and relief workers.

In this work we present a novel solution to the posed challenge, the combination of a Mobile Tracked Rover (MTR) with an Multiple Material Deposition (MMD) system. The MMD system adds an additional dimension to the manoeuvrability and utility of the MTR in extreme environments. With the differential tracked drive the rover inherits a stable base, but is typically limited in extreme environment manoeuvrability, in comparison to a rotorcraft drone with poor static stability but uninhibited manoeuvrability. The MMD system allows the rover to deposit expansive material for real-time climbing support, allowing it to climb or bridge previously insurmountable obstacles. The MMD also allows the MTR to deposit material accurately, essential for effective damaged structure reinforcement where material will need to be strategically placed. The MMD has been developed to support deposition of a number of materials, and the platform has been optimised in simulated disaster scenarios. One such material is polyurethane foam, the characteristics of which allow easy deposition, expansion and solidification in short enough time to enable the rover to use the substance as a real-time support for climbing. The high compressive strength of the polyurethane foam is sufficient for temporary support structures, or structural reinforcement allowing the MTR to operate in support of disaster relief workers. An additional feature of the MMD is its ability to deposit clay, making it able to repair damaged masonry, further improving the MTR utility in more general maintenance and repair scenarios. The proposed approach has been implemented using NX Open in Siemens NX as the platform for system development. Five real industrial parts are used as test examples. The result shows that eighteen feature types are successfully recognized to accommodate intersecting and isolated machining features with variable topology.

Biography:

Alec John Burns received his PhD in Robotics and Autonomous System in 2019 from the University of Liverpool. From June 2015 August 2015 he was a research assistant on a joint project between the Department of Earth, Ocean and Ecological Sciences and Engineering Department at the University of Liverpool working on fluid flow analysis for magma chambers. Currently he is a Research Fellow at the University College London, is field of interest includes robotic and autonomous systems for applications to construction and discaster scenarios.

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