Innovative manufacturing head dedicated to large scale metal additive manufacturing

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Keywords: DED, Large scale, Innovation, Additive manufacturing, Coating

The field of additive manufacturing includes a wide range of materials and part dimensions. When focusing on metal additive manufacturing, and more specifically on directed energy deposition (DED), numerous technologies are currently implemented and further developed, each characterized by a given level of accuracy and deposition rate. These parameters directly influence the capability to manufacture complex or simple geometries, ranging from small components to multi-meter-scale structures. Large-scale components require high deposition rates, which generally lead to a reduction in overall build resolution. Existing and emerging technologies within this category tend to converge toward a similar objective: increasing the deposition rate to enhance productivity and consequently reduce manufacturing costs.

In parallel, process control during manufacturing is a critical factor, as refined control directly affects the overall quality of the build. For this reason, industry seeks reliable technologies with robust and simplified operation, aiming to reduce dependence on manual intervention during production. Real-time control over key process indicators is therefore essential to ensure process stability, repeatability, and consistent part quality.

The current project aims to develop a novel manufacturing head for DED and coating applications, targeting high deposition rates while maintaining process quality. It is conducted within a Research to Business initiative co-financed by Business Finland and Tampere University. The objective is to increase the technological maturity of the concept while preparing its commercialization. A laboratory-scale proof of concept will be developed and initially validated at partner facilities.

From a technical standpoint, the development is structured around targeted problem-solving strategies addressing the inherent complexity of the metal additive manufacturing process. The challenge can be formulated as a multi-objective optimization problem involving process speed, process scale, and process quality. Maintaining an appropriate balance between these parameters is essential to meet industrial requirements and ensure technological and economic relevance