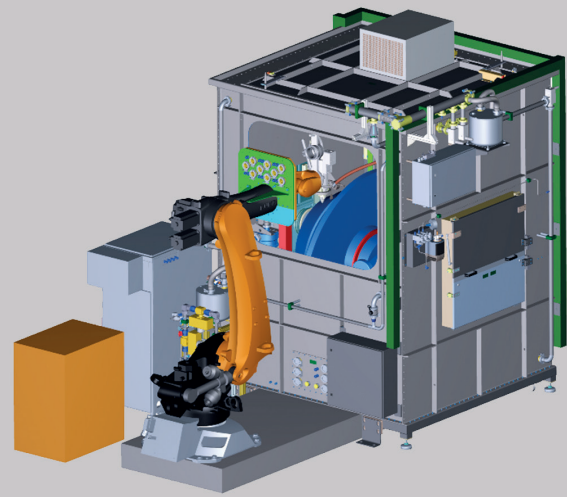


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## ROBOT-BASED HYBRID ADDITIVE MANUFACTURING

### Task

In the future, new approaches will be needed to produce components with increasing complexity, but also cost and resource efficiently. A promising concept to accomplish this is the combination of conventional and additive manufacturing processes. This so-called hybrid additive manufacturing is being qualified at the Fraunhofer ILT as a cost-effective, flexible and high-quality process. In order to enable economic use, Fraunhofer ILT is developing suitable processes as well as robot-based system technology and software solutions in the BMBF-funded project »ProLMD«.

### Method

Laser material deposition (LMD) is a process suitable for hybrid additive manufacturing because it has geometric flexibility and can use a wide range of alloys. In the ProLMD project, Fraunhofer ILT is investigating LMD processes with increased deposition rates of up to 2 kg/h and additives in wire and powder form as well as the local functionalization of conventionally manufactured components.

The use of robot-integrated, geometric measurement technology is intended to implement precise adaptive path planning for the deposition process. For this purpose, the ProLMD consortium is developing an innovative robot-based system setup with a flexible shielding gas solution as well as a novel processing head for laser material deposition. Processes are being developed for materials such as iron and nickel based as well as titanium alloys.

### Results

Robot-integrated line scanning for digitization and quality assurance was successfully demonstrated. After the path accuracy of various robot configurations was investigated, one configuration was set up and tested with a flexible inert gas cell. Fraunhofer ILT has already manufactured and analyzed material samples with build rates of up to 1.5 kg/h. An adapted adaptive CAM solution is currently under development.

### Application

The hybrid additive manufacturing processes have been studied for use in aerospace, tooling and turbo machinery, but can also be applied in many other applications.

The R&D project underlying this report is being carried out on behalf of the Federal Ministry of Education and Research (BMBF) in the program »Innovations for the Production, Services and Work of Tomorrow«.

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3 Robot test cell with ProLMD machining head.

4 CAD model of a flexible shielding gas cell.