Fraunhofer
EMI

FRAUNHOFER INSTITUTE FOR HIGH-SPEED DYNAMICS,
ERNST-MACH-INSTITUT, EMI

FRAUNHOFER EMI – SPECIALISTS IN HIGH-SPEED DYNAMICS

The Ernst-Mach-Institut is undertaking research in the field of high-speed processes in experiment, modeling and simulation. We analyze dynamic processes from a physical and engineering perspective and develop solutions for industrial applications. We consider the aspects reliability, efficiency, sustainability, resilience and safety of structures, components and systems under highly dynamic and extraordinary loads. Our applications range from component optimization and design of structures to research on entire vehicles and technology systems, from buildings, infrastructures and urban systems to networks and satellite systems.

Joining competences for the 3D design of structures under dynamic loads

Our extensive experience in the field of material and component testing with sophisticated diagnostic techniques from high-speed video cameras to micro x-ray computed tomography, experience in material characterization and modeling as well as numerical simulation and optimization is complemented by our offer to customers with our expertise in transferring numerical solutions for optimized design into real parts and components by 3D printing. In-house 3D printed design solutions can be optimized, tested and analyzed iteratively. Thus we can offer a custom-tailored innovation cycle for parts or components.

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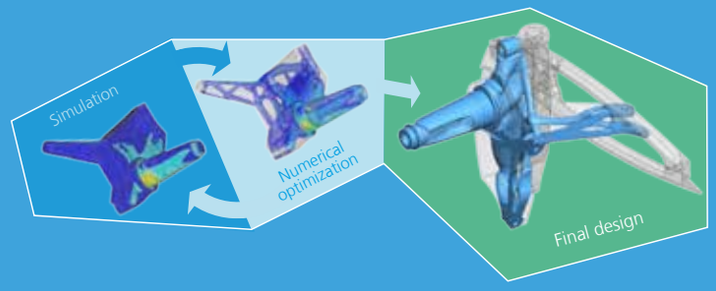
STRUCTURAL DESIGN AND ADDITIVE MANUFACTURING



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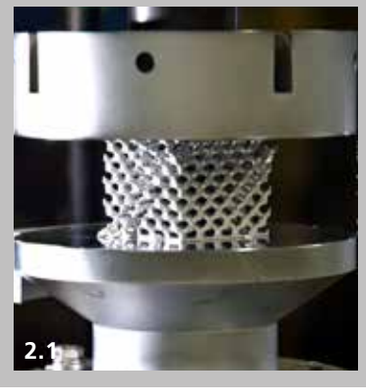

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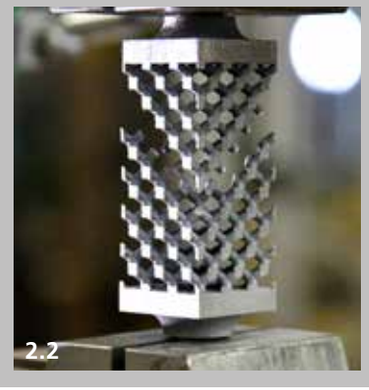

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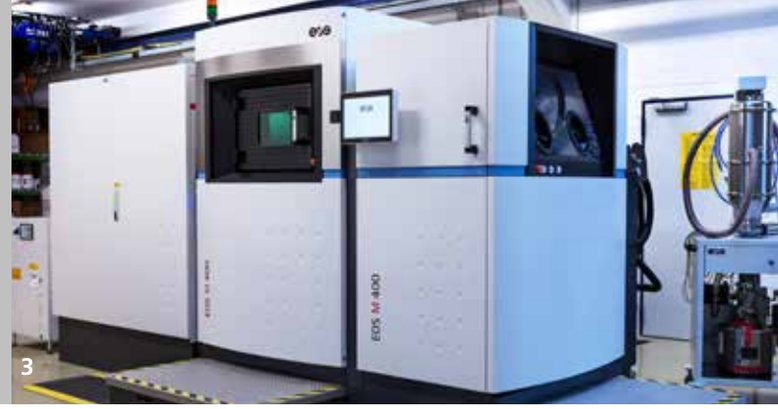


3

ADDITIVE DESIGN – OPTIMIZATON OF LIGHTWEIGHT STRUCTURES

3D printing technologies are especially suited for lightweight design, since according to functional requirements, unnecessary structural material may just not be generated. If load requirements can be determined and quantified, and if suited material models for the construction material are available, numerical optimization simulation can be used to compute the optimum geometrical shape for the structural design.
EMI engages in establishing design rules for the application of Additive Manufacturing technologies – especially in respect of the extreme dynamic load requirements in crash- or impact-related applications. Fraunhofer EMI can offer a unique in-house product development and optimization cycle for large metal components by Additive Manufacturing relying on highly instrumented dynamic testing and optimization by numerical simulation.

ADDITIVE MATERIAL TESTING AND CHARACTERIZATION

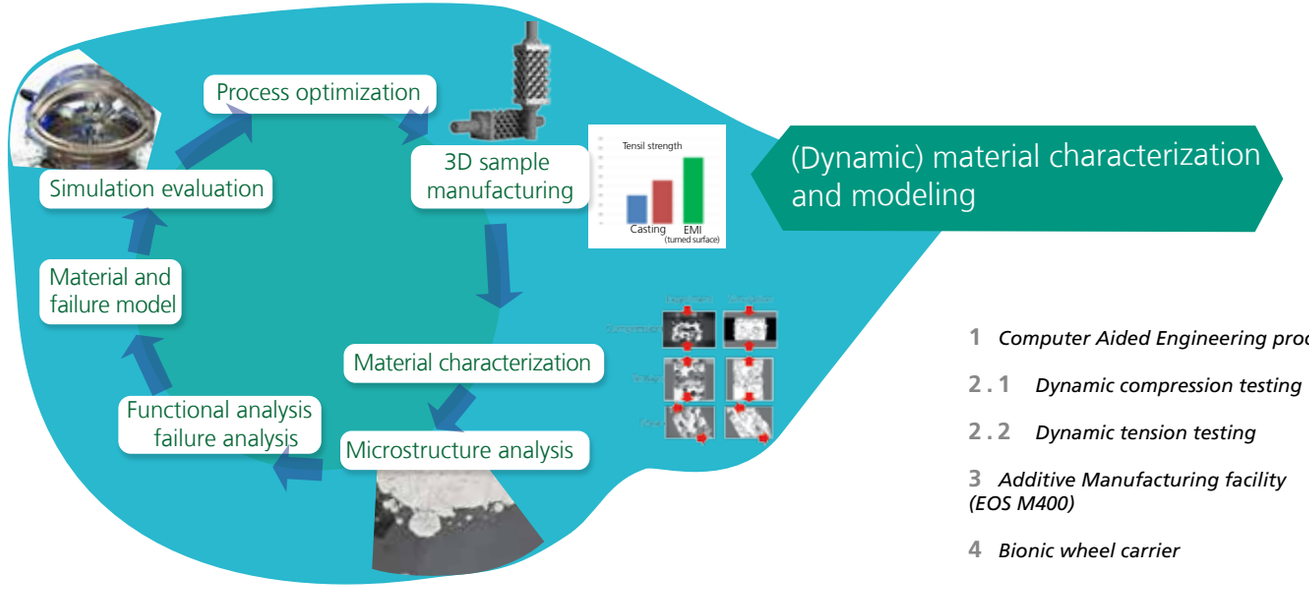
Optimized design relies on the knowledge of material response in specific applications. Fraunhofer EMI offers specific material testing especially in respect to dynamic loads as well as comprehensive characterization in order to derive material models that are used in numerical simulations.

The behaviour of laser sintered metals – especially in dynamic load-related applications – is barely known and will need further research to generate robust simulation models. The material properties of laser sintered structures are closely coupled to process parameters (e. g., laser output, scanning speed) as well as to the post processing (e. g., heat treatment, surface finishing). This has to be taken into account when the material is being tested. As a result, for each application the fitting process parameters can be chosen and correlating material models can be developed and implemented into the numerical simulation tools used for optimization.

IN-HOUSE METAL ADDITIVE MANUFACTURING

In 2015, we established a 3D manufacturing laboratory for Additive Manufacturing of large metal components. Fraunhofer EMI's Direct Metal Laser Sintering (DMLS) system enables Additive Manufacturing of large metal components:

- Dimensions up to: 400 x 400 x 400mm
- Materials currently in production (Status 2016): AlSi10Mg, Ti64 (planned for Q3/16)
- Materials on-demand: IN 718, MS1 and possibly others



1 *Computer Aided Engineering process*

2.1 *Dynamic compression testing*

2.2 *Dynamic tension testing*

3 *Additive Manufacturing facility (EOS M400)*

4 *Bionic wheel carrier*