

# HPC-based Optimization of 3D-Printed Orthopaedic Devices

## Organizations

**CastPrint** is a Latvian SME that provides clinics with custom-made 3D printed casts.

**University of Latvia** provides both expertise in mathematical modelling and optimisation as well as experience and technical capacity in material testing.

**Riga Technical University HPC Center** provides HPC resources and expertise in HPC software setup and is the largest HPC provider in Latvia.



End User



Domain Expert



HPC Centre

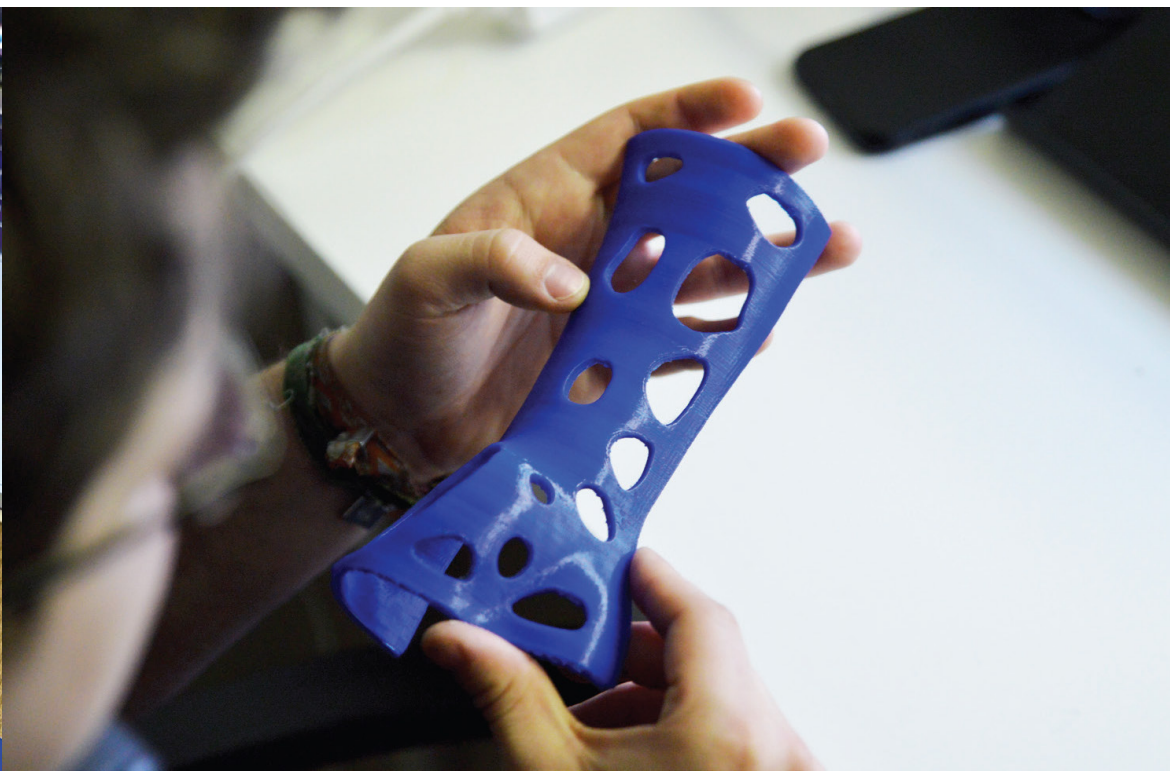


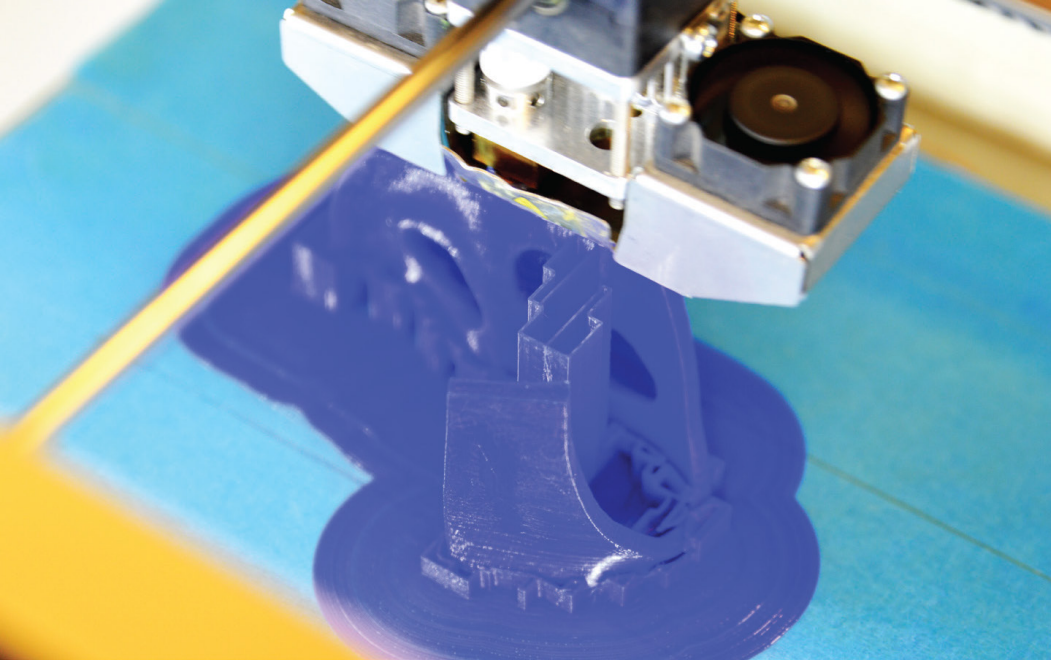
Riga Technical University and Institute of Numerical Modelling, University of Latvia are part of the Latvian NCC.



## The Challenge

While 3D-printed casts deliver patients a high-quality product faster than traditional production approaches, their creation is nevertheless a time-consuming and resource-intensive process. Since the 3D scans used for production contain huge numbers of surface elements, processing the data on typical office computers is both slow and often unreliable, with software crashes resulting in data loss and delayed delivery to patients.





Industry Sector  
**Healthcare**

Technology used:  
**HPC**

## The Solution

To address the identified challenges, the experiment partners have chosen to integrate parametric model optimization into the design process of the medical device. This involves using simulations to determine the most efficient shape for the cast, which in turn reduces the amount of material required and shortens printing times.

Using HPC enables increased computational power and resources compared to a desktop workstation. This enables faster and more effective simulations, automating certain aspects of the design process and ultimately reducing the time spent on it.

## The Impact

Product time to end user decreased by 25%. This is achieved through shorter design and print times for the ordered 3D printed medical devices that reduces production costs by up to 15% and increases production capacity by 25%. Reducing the time between scanning and printing opens opportunities in new markets.

Shorter printing times and less material used result in lower costs and thus CastPrints become more accessible for patients.

Despite the fact that CastPrints are made out of Poly-lactic acid plastic that is made from sugarcane and is biodegradable, a 25% reduction in plastic use means less plastic waste. Similarly, a 25% decrease in printing times results in less electricity consumption used in printing the device itself. This contribution to the reduction of plastic waste and electricity usage is combined with improvements to the durability and wearability of the product.

## Benefits

- A 20% decrease in labor hours for cast design, which also reduces the risk of human error.
- Topological optimization reduces the amount of material used in production by around 25%.
- Reduced production time by 25% through material optimization and shorter printing durations.
- Up to 15% reduction in production costs.
- Enhanced production capacity by up to 25% for CastPrint.