Technical University of Denmark

Popular science summary of the PhD thesis

PhD student	Komeil Saeedabadi
Title of the PhD thesis	Optimization of Injection Molded Parts Using Production Data and Simulation
PhD school/Department	Department of Civil and Mechanical Engineering

Science summary

In the rapidly evolving landscape of microfluidics, integrating simulations with production data for optimizing injection molded (IM) parts has emerged as a pivotal technological innovation. This thesis, conducted as part of the AcouPlast project funded by Innovation Fund Denmark and Vinnova, Sweden's Innovation Agency, delves into the optimization of plastic production for micro and nanostructured devices, crucial for cost-effectiveness aiming to innovate and produce high-value products. The core of this work introduces a unique, repeatable optimization loop, ensuring the production of optimized micro-injection molding (μIM) and IM parts. This approach was employed in various projects, including designing and optimizing a novel acoustic polymer lab-on-a-chip (LOC) that operates based on the material's acoustic characteristics.

The increasing interest in LOC systems, attributed to their versatility, cost-effectiveness, and scalability, has spurred advancements in rapid prototyping, linking the domain to lab-on-chips and organ-on-chips production. The AcouPlast project, aiming to design a polymer device for acoustic particle separation, leverages these advancements to develop a low-cost diagnostic device. This thesis addresses the challenges faced during this project, emphasizing the importance of agility in design alterations.

The potential of LOC devices spans from medical diagnostics to environmental monitoring. However, their development often grapples with design optimization, cost control, and quality assurance. This work underscores the role of injection molding simulations and virtual Design of Experiments (DOE) in bridging the gap between theoretical design and practical implementation. Virtual DOE emerges as a transformative tool, enhancing design efficiency and contributing to the final product's quality.

The challenges of simulating the μIM process, given its micro-scale considerations, are explored in depth, with a focus on understanding the disparities between simulations and actual production outcomes. Furthermore, the intricate relationship between the IM process and the acoustic properties of polymers is dissected, emphasizing the potential of the digital shadow for process optimization. In culmination, the thesis chronicles the journey from theoretical simulations to tangible results in the AcouPlast project, highlighting the challenges and methodologies employed. The comprehensive exploration of the entire process chain, from initial simulations to final acoustic tests, offers a holistic understanding, ensuring replicability and setting the stage for future advancements in the field.

Please email the summary to the PhD secretary at the department