Research theme	Synthesis based engineering tools
Research title	Synthesis tool design for conformal cooling channels in injection moulding
Researcher	Laurens Hoek
Research period	From December 2014 to November 2015
Company	University of Twente
Supervisor	Juan Jauregui-Becker

Background

Synthesis based engineering tools are developed and tested at the university to confirm if these tools can create viable solutions to design problems. These tools create algorithmic designs using a scenario set forth by a designer. This is contrary to the conventional case in which the designer creates a design and then analysis it to see if it fits the requirements. A synthesis tool can create multiple designs and therefore offers the possibility to explore the solution space. With greater knowledge of the design space, it is possible to create designs in a shorter time and with greater quality.

Cooling channels in injection moulds are typically complicated to design and require several simulations and design iterations. They are however very important for the production time and quality of the part. Using synthesis tools can remedy these problems.

Assignment

The focus of this research is to design a synthesis tool for cooling channels in injection moulding. Since there have been multiple attempts to automate the design of cooling channels, a literature review was conducted to determine the approach. This concluded that a tool would be designed which would be based on theory and less on rule of thumbs while taking into account the various other components and limitations of the mould. The tool serves as a proof of concept of this new approach. It was also determined that the tool would create conformal cooling channels, channels that follow the contour of the part. This creates more design freedom with respect to conventional designs, and increases performance, but requires additive manufacturing to produce the moulds.

Using relatively simple two dimensional models for heat transfer, fluid dynamics and mechanics of materials, preliminary dimensions of the cooling channels were found. These dimensions, in combination with an earlier model which determines which parts of the mould need cooling, serve as a basis for the three dimensional geometric design. Using a modified A* algorithm, as well as several other algorithms, the geometric design creates geometries suitable for a range of different parts and scenarios.

Results

The synthesis tool is able to accurately design cooling channels. Simulations in Moldflow showed that the designs made by the tool can be successful, at least for relatively simple parts and moulds. Some more work has to be done for the tool to accurately describe flow characteristics of the coolant (such as pressure drop). Also, more validation is needed to test the model with more detailed and complicated parts and moulds.

Personal experience

Working at the university gave me the benefit of working on this new and interesting field of work, which is barely used in the businesses sector. It also gave me the possibility to quickly access know-how and knowledge. Working on synthesis tools gave me a good opportunity to improve my programming skills and to tackle design challenges from a different perspective.