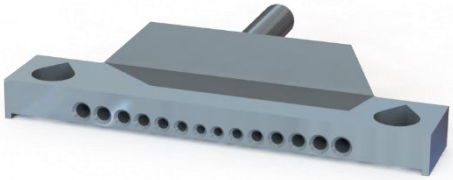
Public Summary

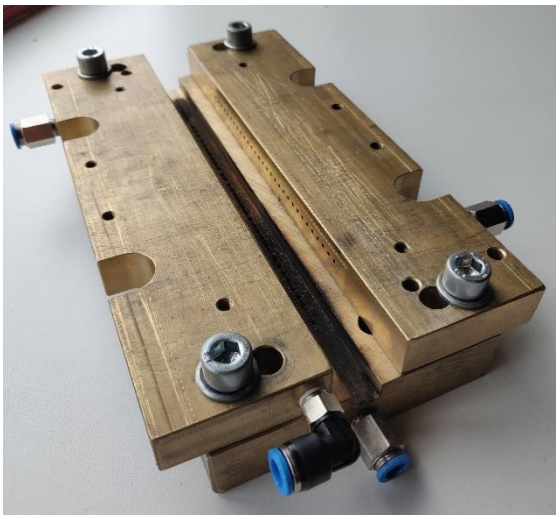
This research explores the capability of the fused filament fabrication (FFF) process to create fixture assemblies which can be used for special cases of laser welding. AWL is a company which partly focusses on welding techniques. One of these techniques, laser welding, is increasingly popular due to the applicability in (fully) automatic production lines. The research department is constantly looking for new alternatives which can enhance automatization and machine quality, to keep up with the fast-moving technology. Therefore, recently a Desktop Metal machine was ordered, which is one of the more user friendly metal 3d-printers. To already get acquainted with the 3d-printing process, two desktop FFF machines are bought, which have already proven their use in many projects. The machines are two Ultimaker models 5S.

Laser welding is a precise joining technique for which, in production, complicated jigs are used. However, in some scenarios such jig is not available. In those cases, a fixture assembly is created with a combination of standard fixation tools and custom-made fixtures. However, complex welds can require complicated fixture assemblies with numerous components and are often difficult to create. Furthermore, sometimes the custom-made fixtures contain features which are very difficult to produce. Since the FFF process creates the possibility to quickly produce complex geometry, it could be a great advantage to use in the production of these assemblies.

To answer the main research question “How can FFF additive manufacturing be used to produce fixtures for weld optimization, if possible?”, the simple custom-made fixture assembly which is shown in the right figure, is recreated using the desktop FFF machines. Therefore, part of this research is spent on gaining knowledge about the FFF and laser welding processes. Using this knowledge, the main concerns when designing for FFF are used mapped and used in the final fixture design.
Furthermore, since the polymers suited for the FFF are usually not selected for the laser welding conditions, a careful material selection process is used. From this process can be concluded that PET-G and Nylon show potential for the fixture application. Since reinforcement by carbon fibre was found to increase mechanical, thermomechanical and printing properties, for both materials a composite was found and included in the research (Chandrakant Gavali, Kubade, & Kulkarni, 2018; Love et al., 2014). The knowledge of the FFF and laser welding processes is then combined to design a fixture which is optimized for the FFF process and the fixture application, which is shown in the left figure. Finally, experiments are performed on the durability and maximum capacity of the selected materials. This is done by printing the fixture design and using it to weld pieces of sheet metal.

The FFF process shows potential to be used for this fixture application. However, although a PA carbon fibre composite shows potential, extensive research is needed on the boundaries of this and





potentially more suitable materials in fixture assemblies. Moreover, some factors are left out during the experiments, such as reflection, of which the effects should be studied. Finally, full implementation of this concept can only be achieved when a new thinking process is taught to machine operators and engineers. However, this research is only the start of this process and much research on the applicability of this concept on different scenarios is needed before full implementation.