Bachelor thesis (BT) on Additive Manufacturing (AM) processes

History and development of AM

First of all, it is important to note that development of AM technologies can’t be separated from development in related fields. We can say that AM machines consist of many intricate sub-systems. For example, very precise and fast positioning system are required. Powerful lasers are used to melt and fuse material together. Computers, microcontrollers and electronics in general are required to control the environment and guide the build process. Last but not least, materials were developed to suit specific AM technology. Without these and many more improvements, there would be no machines like the ones today. When we compare nowadays machines and the ones from AM beginnings, there are big improvements. First machines could be slower, less precise, encountered material behavior problems, more buggy, but most importantly – much more costly.

As mentioned in the introduction, AM has been out there longer than it might appear. It is not technology of 21st century, but it originates in 1970s / 1980s, when there were only conventional methods. For the first time, attention was paid to possibility of curing photopolymers into specific shape in 70s. An idea was developed to make use of additive production using layer approach – construction of separate layers, merging into final product.

Zdroj?

The first AM technology commercialized was Stereolitography. There were experiments with curing layers of photopolymer resins simultaneously, thus creating separate layers. It was in Japan in 1981, when first schematics of possible technology using photopolymer-hardening were described and proven to work. Later in 1984-1986, Chuck Hull filed the patent for the first working machine. In 1986 he also founded “3D systems” company, which was probably the first company to do business with 3D printers. Nevertheless, Chuck Hull is important for his contribution to 3D printing field by major work on the “STL file format” – a specific format used by computers for describing the geometry of fabricated parts. (Will be described later)

Next technology that emerged later was “FDM” (Fused deposition modelling). This technology is using material in a form of wire, which is molten and deposited into a single layer (described later more). The patent for FDM was filed in 1989 by S. Scott Crump from Stratasys Inc. - also very important company in AM business that is still in operation.

In the first half of 90s, other technologies were starting to be commercialized. They usually went under their specific names like SLS (selective laser sintering) of LOM (laminated object manufacturing). These technologies were filling in gaps in missing technologies as Powder bed fusion, Sheet lamination, Material jetting and Binder jetting. There is probably no need for naming all individual patents. Still we have to realize that patents have a major impact on development in AM. Technologies, processes and even materials from AM are subjected to patents. When patents are no longer held after 25 years, the competitiveness of other companies grows, resulting in bigger supply of AM machines available, thus also in their price reduction. Expiration of patents was one of the reasons, why we experienced rapid growth of FDM machines.

Zdroje?