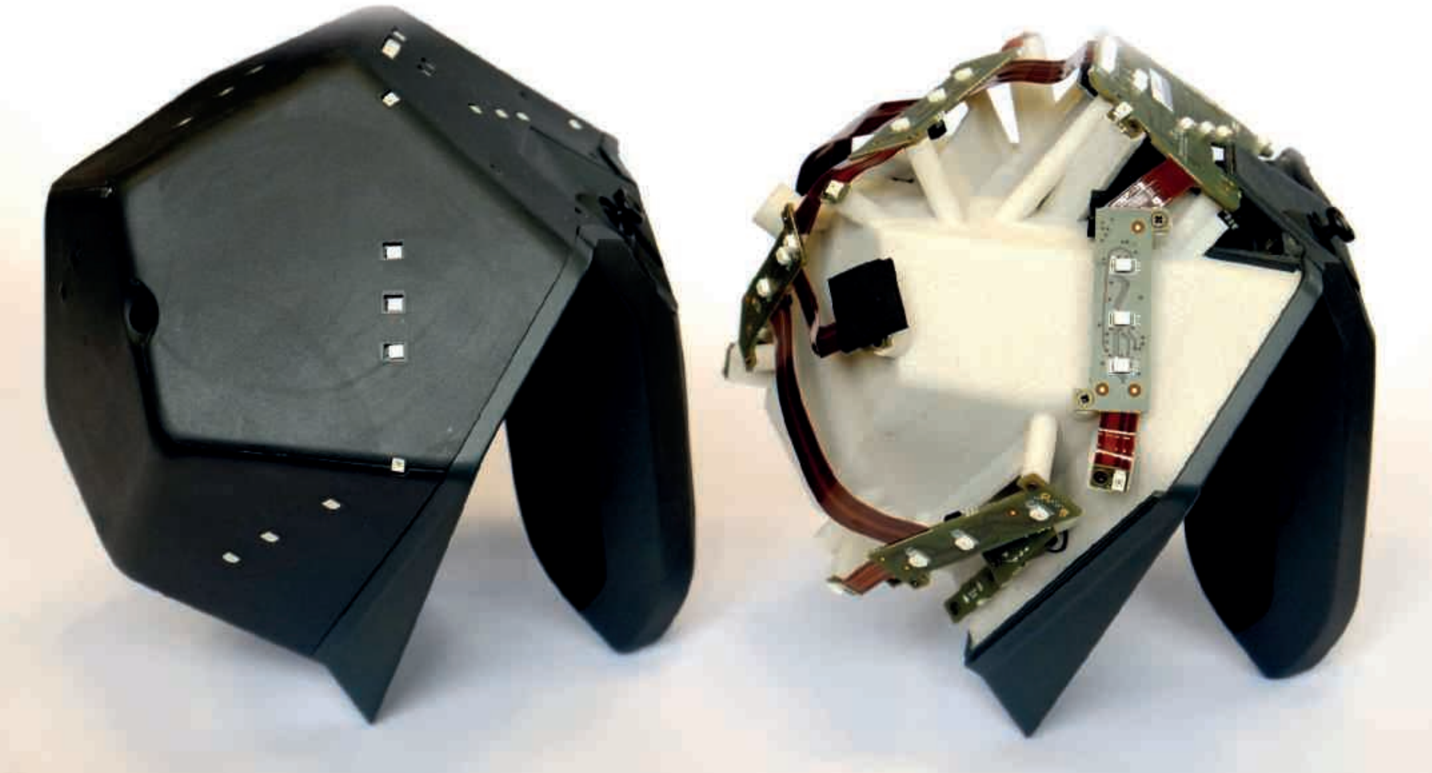

Photo: Courtesy of Vicon Motion Systems Ltd

Designers think outside the box

Bored with having a standard box to house your fancy electronics? 3d printing has come of age and is allowing a bit more flair. By **Tim Fryer**.

The first thing to clarify is that 3d printing is really the buzzword that has captured the imagination – a better description that includes a broader set of processes is additive layer manufacturing (alm), and these processes are rapidly gaining widespread acceptance.

While this technology might conjure images of impressive, but slightly pointless, rubber dinosaurs, recent improvements in the capabilities of alm machines have bought the technique into the mainstream – and the electronics industry is one of those which stand to gain.

Barry Assheton is sales director of CRDM, a rapid prototyping bureau that uses alm technology. "I think electronics is in the front line for being affected by this technology. I hesitate to say 'new', because it has been around for more than 15 years for metals and 20 years for plastics, but the turning point for its usage has literally been in the last year – its moved on that recently."

Although perceived as a prototyping technique, ALM has become a viable process for low volume manufacturing as speed, quality and capability have all improved. So now the electronics designer can design a housing or enclosure unfettered by the constraints of having to make it manufacturable.

"We are making things that could not be made using machining, so designers are being a bit more outrageous – thinking outside the box – which is really advantageous," said Assheton. "Years ago, we were teaching design engineers how to design for manufacture. A young engineer, fresh from university, was not a suitable candidate to design an important product because they didn't have the experience of manufacturing. Now, that young, inexperienced individual with no manufacturing knowledge is advantageous because they are not restricted by implanted processes. If it's going to go to volume manufacturing and is going to be made by CNC

Prototype to production

David Reynolds of Vicon Motion Systems commented: "With the help of CRDM, Vicon has used alm extensively throughout the development of our new Apex hand-held tracking product (pictured above). We have used these technologies for some years for rapid realisation of designs in the prototype phase of development. For Apex, for the first time, Vicon is using alm for full production parts. This technology allowed us to design a complex shaped part on which to mount our electronics with sufficient accuracy to be used in our optical motion capture systems. A further benefit, as this part does not have expensive tooling, is that we have the freedom to iteratively improve the design in production."

One of the sintering machines in action at CRDM and (right) direct metal laser sintering of maraging steel powder

machining or die casting, that is different, but this process allows the flair of being able to have creativity and think outside the box – look at the design as a design, not something that must be suitable for manufacture."

ALM has other advantages that tie in with this creativity. A housing that is designed to be compact and complex, although perhaps not manufacturable using conventional machining, could well be smaller and lighter weight. Equally, when machining a housing, up to 75% of the material is created as waste – and if that happens to be titanium at £50/kg or another high value material, then this is an important consideration. Less than 5% of material is wasted in ALM.

Although cost saving is not a prime consideration, having complex and light weight parts are key considerations in Formula One, and CRDM's machines have been fully employed throughout March for F1 teams as they tinker with their new cars at the beginning of the season. Of the host of new materials now available for the ALM process, cobalt chrome is one that is suited for these high temperature, under the bonnet applications. Assheton commented: "This is small volume, but they like the freedom of design. They can design something radically different just to reduce a lap time by 0.1s."

ALM processes

As stated above, there are variations of the ALM process. For metals, the process involves printing a thin layer of powder. The thickness of this layer, typically 40μm at CRDM, is one of the factors that determines the quality of the end product. This layer is then sintered by a laser in the pattern programmed by CAD. The software breaks down the CAD model into these 40μm slices for 'printing'.

Plastic parts can be grown using the same methodology, although they can also use resin, rather than powder, which is cured using a UV laser. Plastics can also be grown using the true 3d printing process, which directly lays down thin layers of polymer through a nozzle.

There are clearly times when plastic enclosures can form a desirable housing for electronic circuitry, but in general it will be the metal options that will be of interest. Materials available include DM20, a bronze porous alloy used for tool making and prototypes. Cobalt chrome features high corrosion resistance and strength and is used for direct part manufacture, medical implants and high temperature applications. There is also a selection of stainless and maraging steel grades with different properties to suit different applications.

However, for the electronics industry, Assheton sees a champion emerging from the list. "There are differences for all these materials in terms of cost, weight, strength, performance – but obviously the one that is going to have the biggest growth in terms of housings for electronics is aluminium. It's cheap and light and user friendly. It has a lot of advantages. Not only is aluminium one the most widely used materials in electronics housings, we see another huge opportunity for it in heat sinks. A heat sink can be quite a complex shape. In high volume, manufacturers try to extrude it, but extrusion doesn't suit when you have to fit the parts into a small, compact electronics housing. The ability to grow the part for prototype or product is very attractive and I think this is potentially a big growth area. Aluminium is definitely the material I see dominating the market in the next five years."

Another consideration is that as prototyping in metals and plastics has become so much more advanced, the CAD systems have had to improve. "The quality of the CAD model is now very important," said Assheton. "If you have a poor quality CAD model, it will either come out as a poor quality part or even in some cases one that cannot even be built. We need to be supplied with high quality CAD to avoid getting faceting in the product. Typically in one of three file formats – SPL, STEP or IGES – which are common formats for mechanical designers." Facets, for those who don't know, are the flat sides that go towards making a curved edge. The smaller the facets, the better the curve appears and this is a product of the CAD quality.

Adoption will ultimately depend on cost according to Assheton: "It is a combination of complexity and requirements. Our cut off point is up to a few thousand a year, but part of where that cut-off falls is how complex the part is. There can be a part that is very simple to make where there may not be a cost saving to using this process. On the other hand, some parts are beyond straightforward manufacture by machining, in which case the savings could be very attractive."