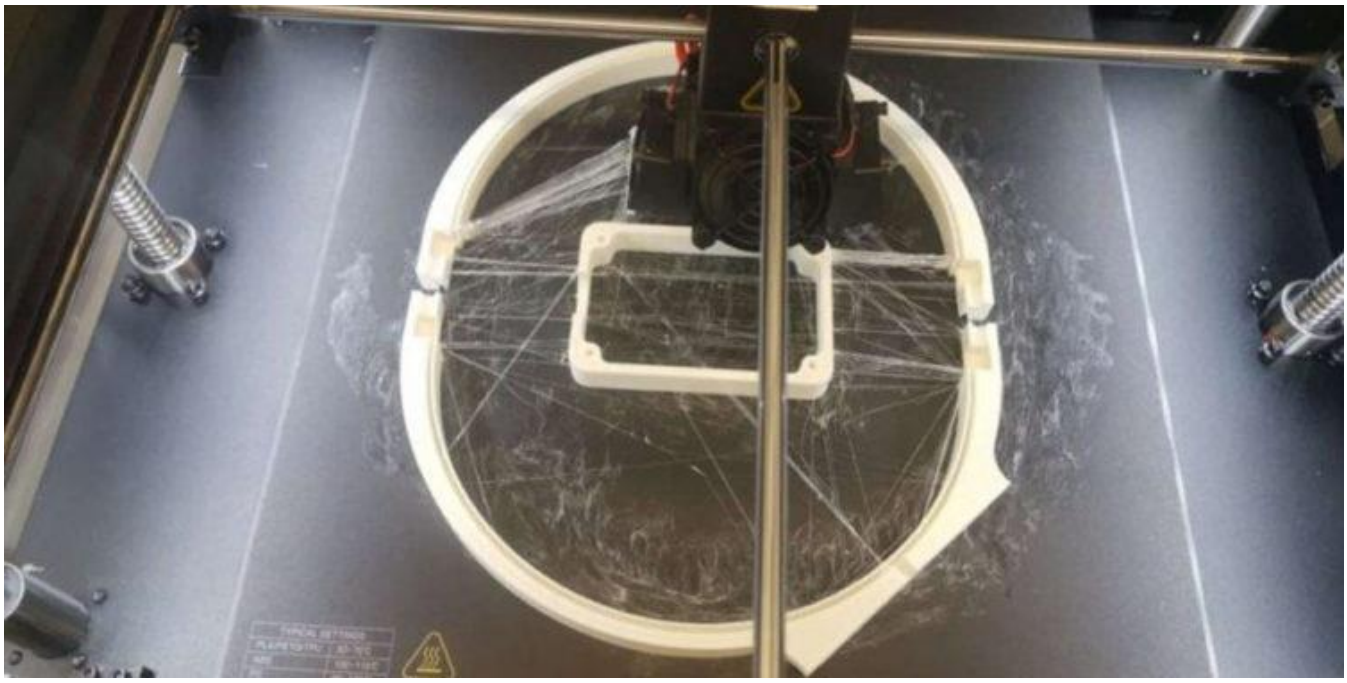
Raise3D 3D Printer in Medicine: MRI Maintenance

Raise3D Case Study
Oct 20, 2020

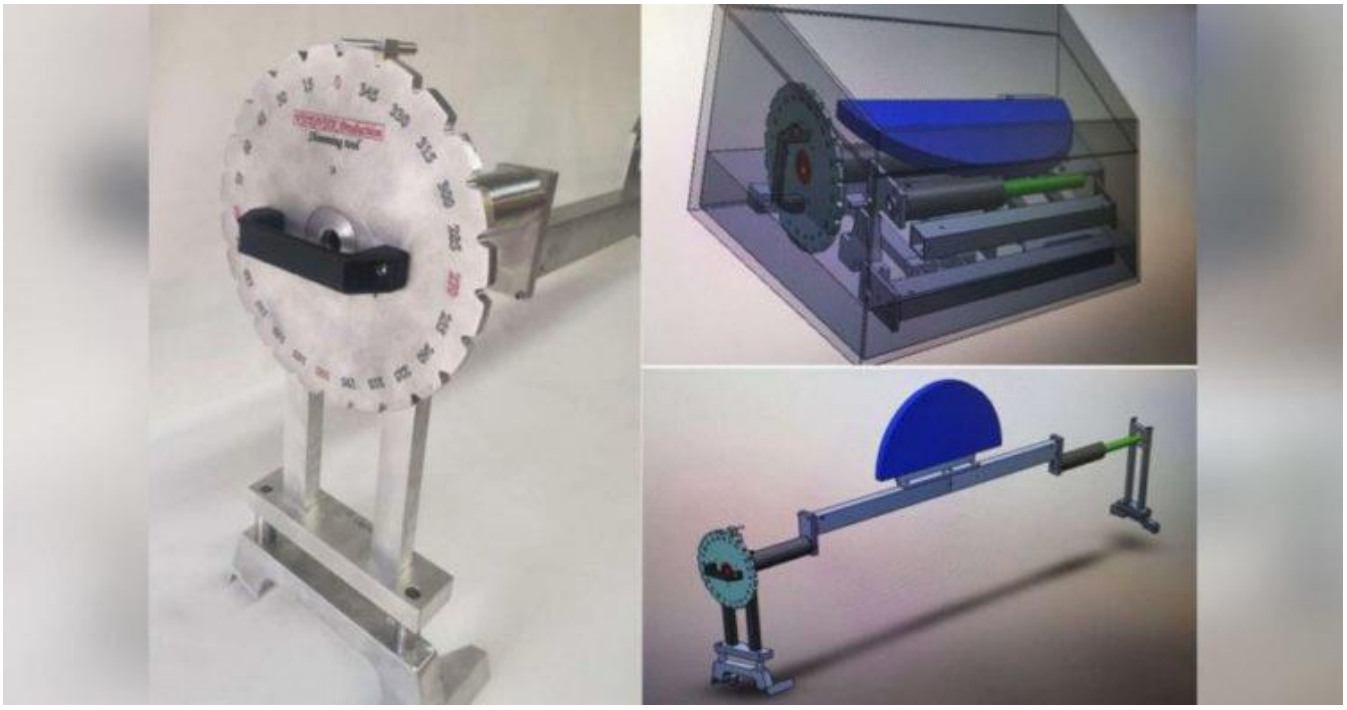
Magnetic resonance imaging is the most modern and effective diagnostic method that can help doctors accurately diagnose several health problems. MRI technology has a number of advantages over CT (Computerized Tomography) and radiography. First of all, it is safer for people and the results obtained are more accurate, with the major drawback being the rather high cost of both the procedure and the machine itself, as well as the price of accessories and auxiliary instruments.

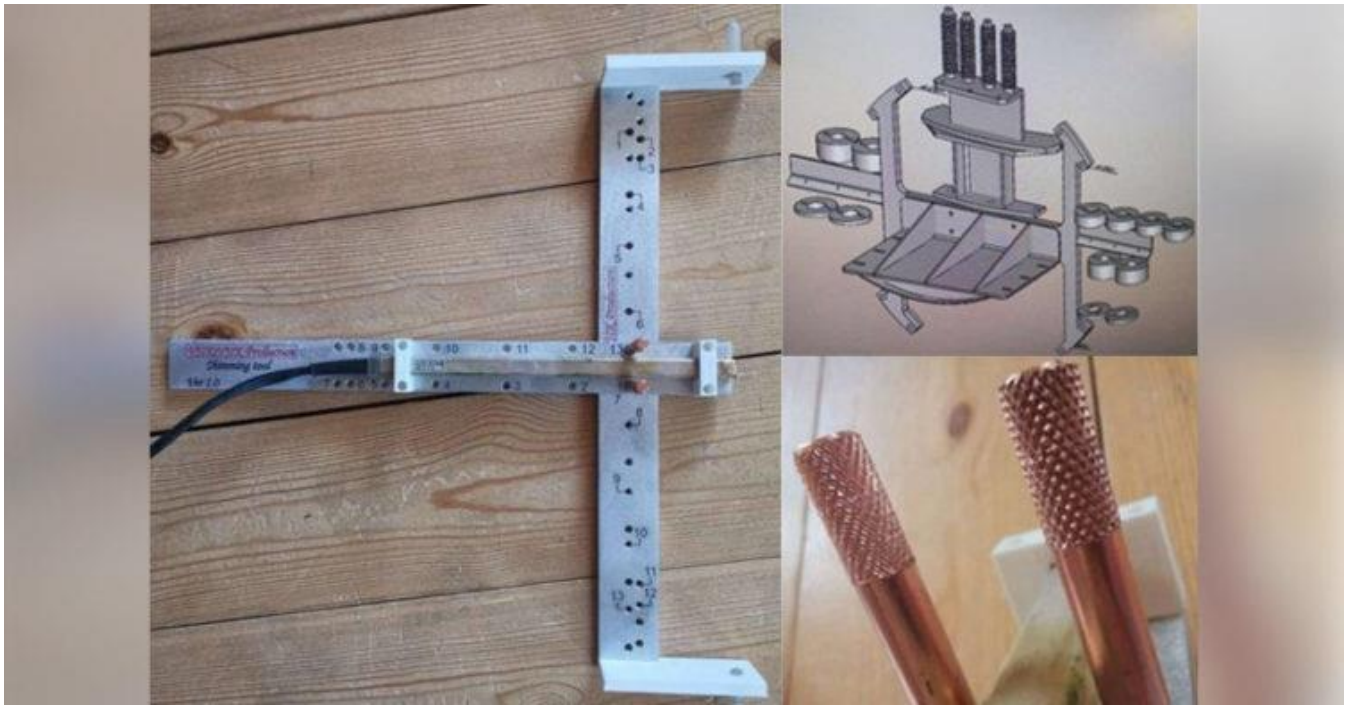
Vitaly M. from the «MRT-Service» company, which sells and maintains MRI / CT and X-ray equipment, actively uses 3D printers in its activities and told us about how 3D printing can help in the sale and maintenance of MRI.

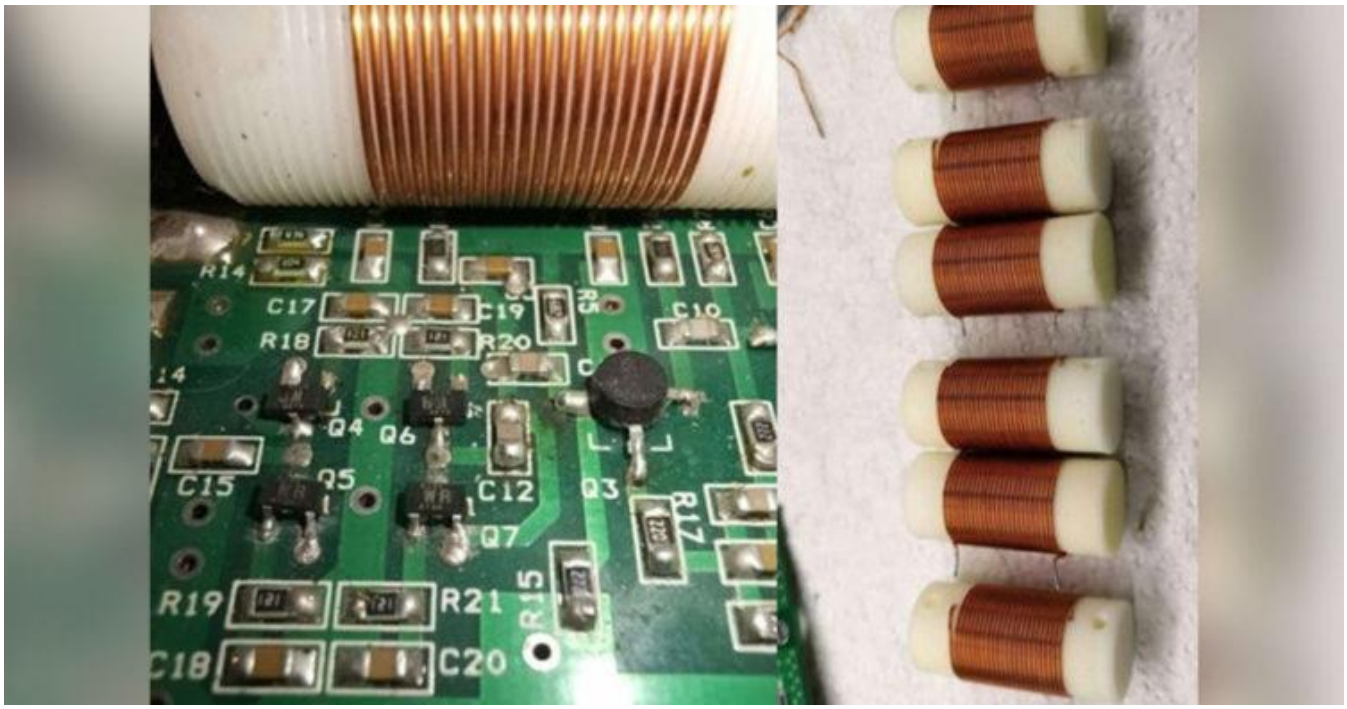


How are 3D Printers Used in the Service Sector of Complex Medical Equipment (MRI, CT, etc.)?

When servicing magnetic resonance imaging machines, expensive devices are required to solve certain problems. For example, to obtain a uniform magnetic field, it is necessary to perform shimming. There is such a thing as a “shim-device”, and this is an expensive tool that isn’t really classified as medical equipment but is required for its proper operation.





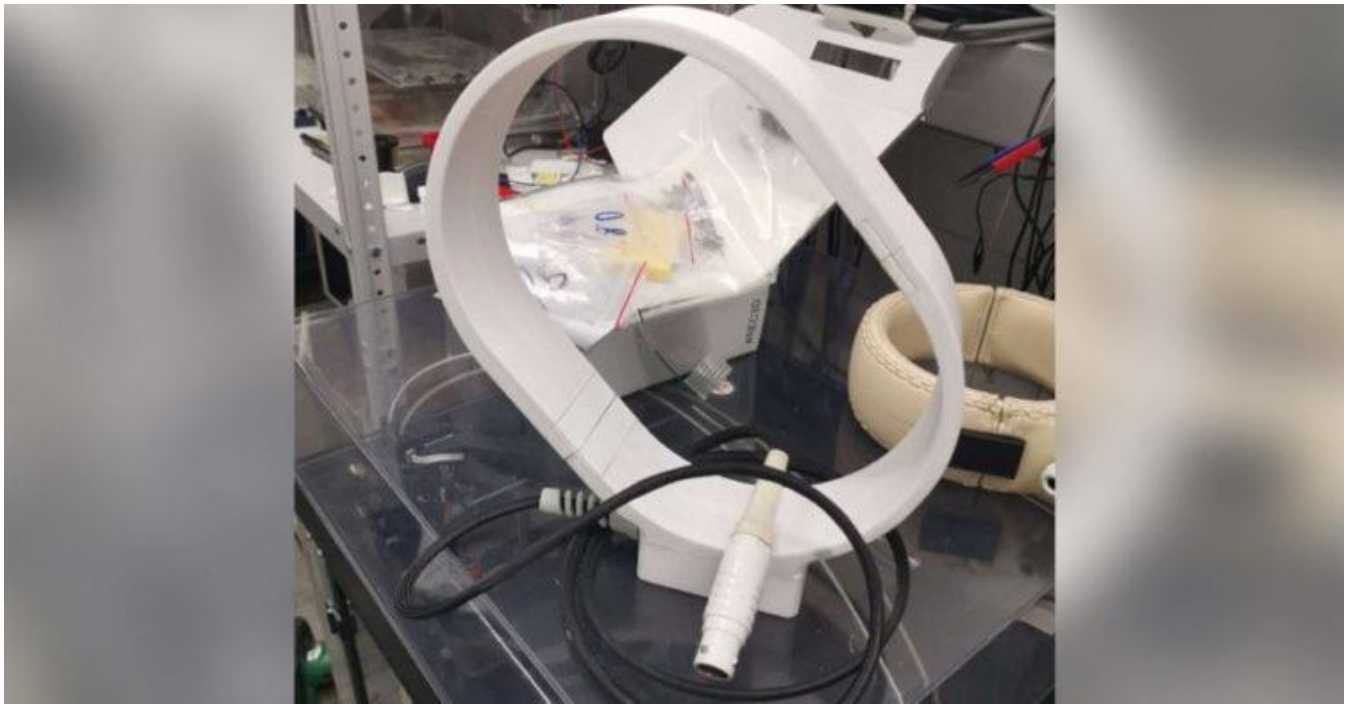


This device is very difficult to obtain, since it is produced in only a few exclusive batches, and is almost impossible to buy.

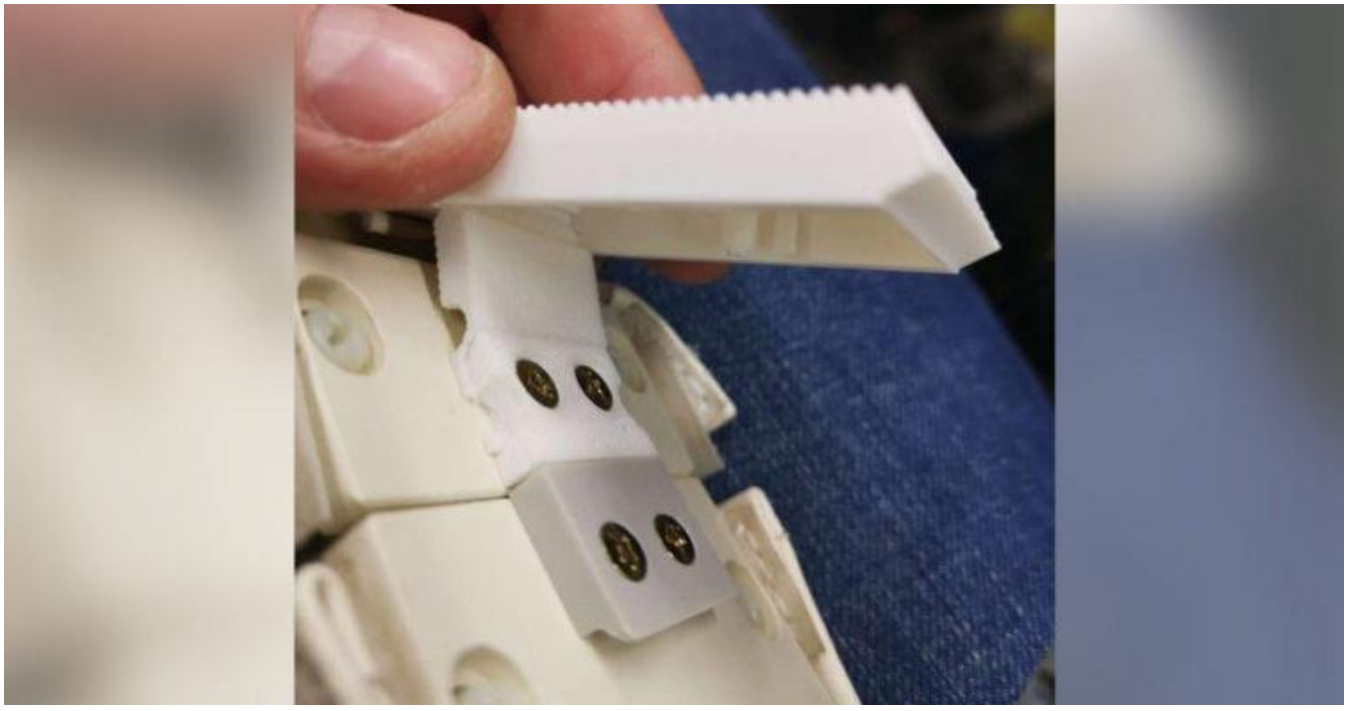
Therefore, it is necessary to make the same device or at least the same prototype. 3D modelling, coupled with 3D printers, makes it possible to produce such a tool.

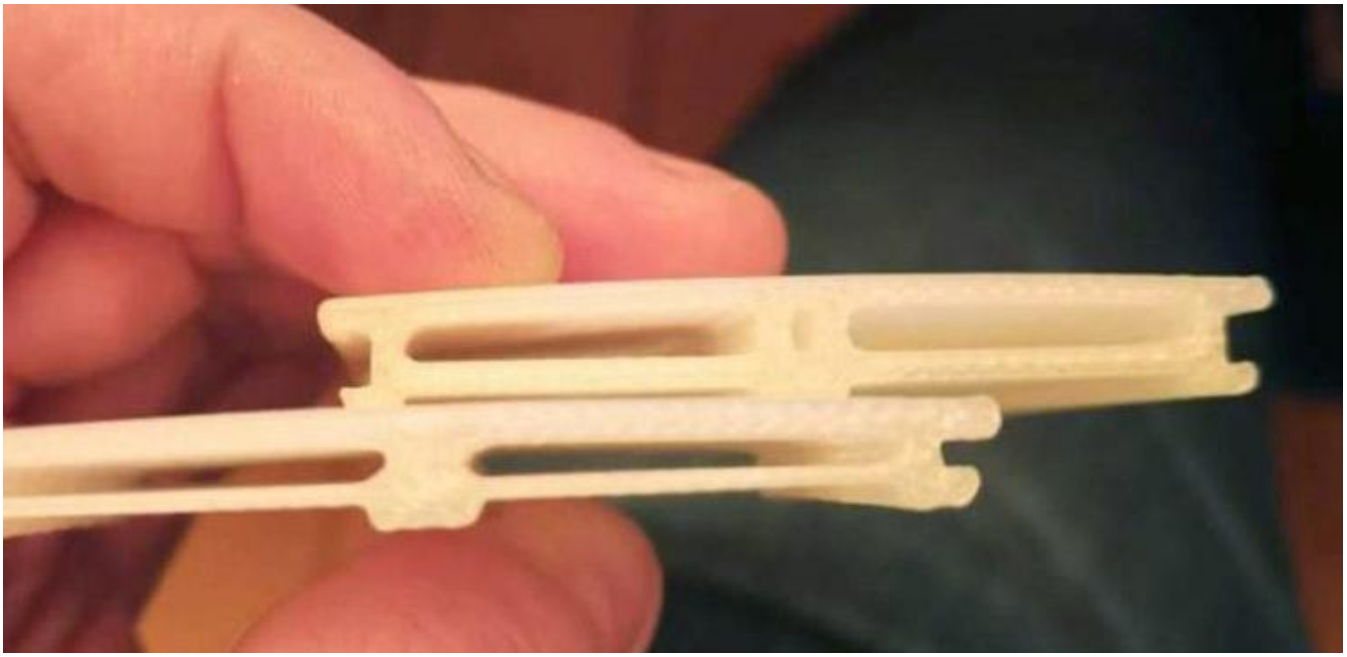
Another of our areas of application of 3D printing in MRI is the development of **antennas for detecting radio interference**. The electronics are located inside the device, but the entire body portion is done on a 3D printer.

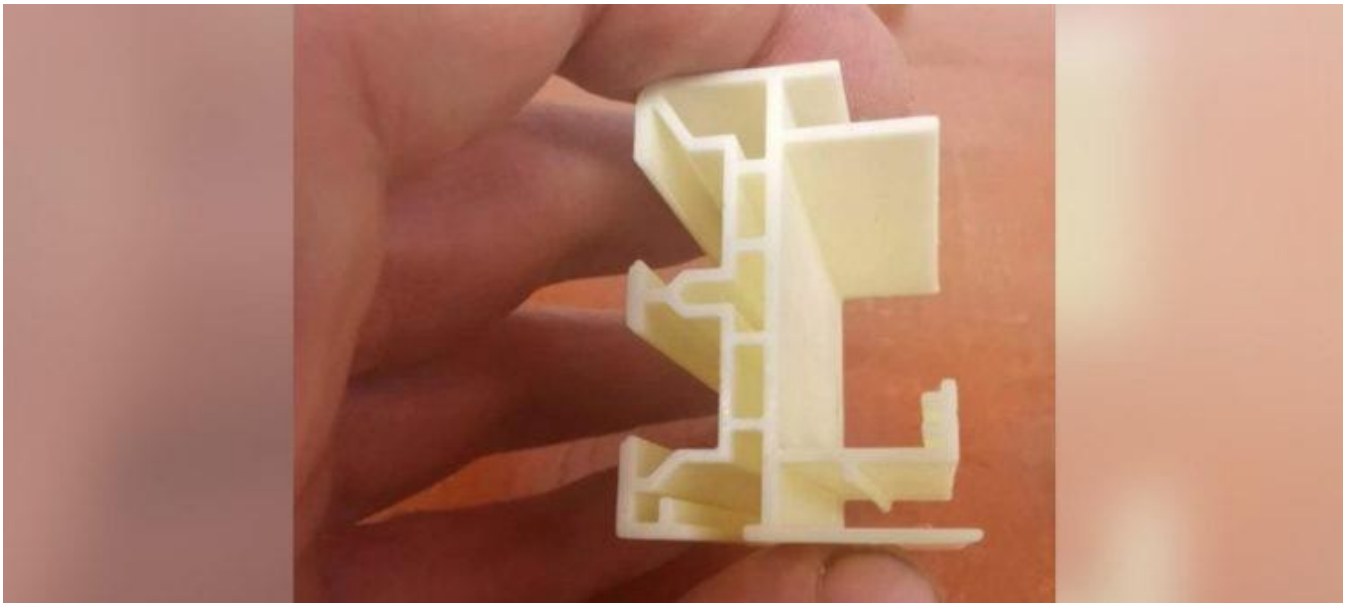
There are also coils for MRI, which will be described in more detail later.



We also print various small details, necessary spare parts, fasteners, etc.







What are these Devices and Tools Made of?

MRI machines work under a magnetic field, so for this reason alone, using steel structures is impossible at it will lead to a distortion of the magnetic field. To avoid this, we use plastic or aluminium.

Regarding plastics, we first used Polymaker PLA, then switched to ESUN. For the most part we use PLA-plastic, as it is made from corn and thus environmentally friendly. ABS does smell when printed, but if it is necessary to make gears, the parts that take the load is are made from ABS. For antennas, as we learned from experience, it is better to use PLA as it is ideal for prototypes. It sticks to the working table perfectly and is processed more comfortably due to the fact that it is more brittle, but this is merely my opinion, probably someone will consider this characteristic as a minus. In addition to printers, we have a 3D-milling machine where we manufacture aluminium elements.

How Long Ago Have You Implemented 3D Printers?

The first printer was acquired in 2016-2017. We now have 3 workhorses – two using FDM technology and one photopolymer printer.

We were looking for a printer that could print large models in a single go with 2 extruders. At a certain point, we bought Hercules, although with only a single extruder, but with a large build size. But it was already “worn out” – about 100 kilograms of plastic were printed on it. And we wanted to switch to something new, modern, reliable, large and dual extruder, so I purchased the Raise3D Pro2 Plus.

If I print a model on one extruder and its quality is of little consequence, Hercules is used. It allows you to print quickly, but of course with inferior quality. And, to be honest, it is a pity to “tantalize” the Raise3D at high speeds as there is an old printer for these purposes and we try to be more careful with our Pro2 Plus.

Raise3D always prints for me if I’m in a workshop or somewhere nearby.

We also had the experience of using a 3D scanner. But in our case, correcting a 3D model after it’s been scanned takes the same time as drawing the model from scratch. When you draw the model yourself, polygons are processed better and there are fewer errors.

Probably the model makes all the difference. If, for example, you need to scan a person, a 3D scanner is beyond compare. But in the case of a gear, a screw or other parts, it is easier to draw it yourself or find an already created model on the Internet (many of them are freely available) and simply finalize it.

Specificity and Efficiency of Using 3D Equipment in the Field of MRI

In our industry, 3D printers have not paid for themselves in business terms. They have paid for themselves with their speed. Time represents labor costs as well as great sums of money, so therefore we spent 1 million rubles on the purchase of equipment, but at the same time, it accelerated the whole production process by 5-7 times.

For example, it took a year to develop an antenna to search for radio interference. Moreover, we spent a month or two on the electronic side, but it took a year to get the final result in terms of appearance, design, and form. Of course, you need to take into account that this is not something that is worked on

every day, everything is done in a step-by-step manner – first we developed a model from scratch in SOLIDWORKS, then printed one prototype on Raise3D Pro2 Plus, then another one, then a third one… In any case, the prototyping process always takes a long time, we had about 10-15 intermediate versions until we came to the final version. You have to produce many, many prototypes to obtain the necessary roughness, to make sure the tool fits well in your hand and is comfortable to use, to optimize the shape and so on. 3D technology is what allows you to do this fairly quickly and at a low price. If we didn't make prototypes ourselves, the process would be drawn out into several years.

Antenna after printing on Raise3D Pro2 Plus

Antenna after printing on Raise3D Pro2 Plus

Antenna painting process

Antenna painting process

Finished antenna

Finished antenna

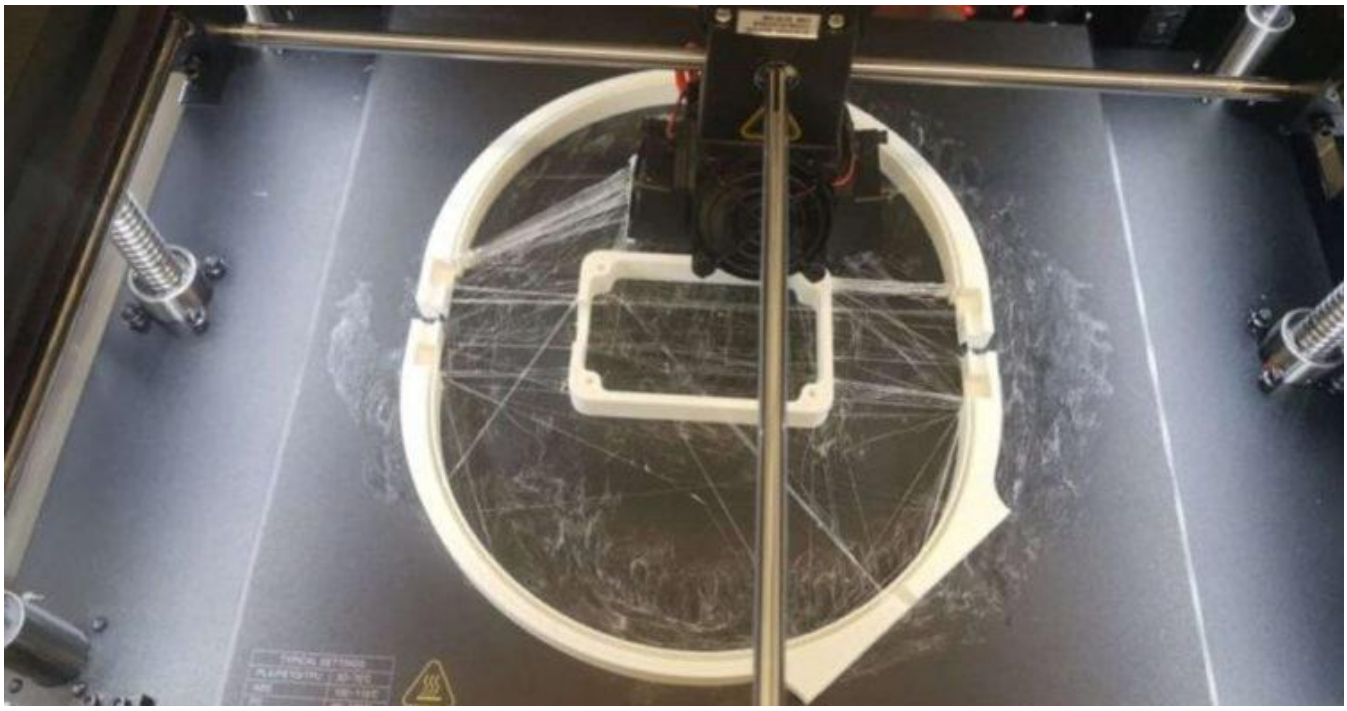
Packaged antenna in its complete package

We print all our prototypes from plastic on a 3D printer, and as soon as we get the ideal, “corrected to a dot” version, we send the model to third-party companies to create the final polyamide product on an industrial 3D printer. The accuracy and quality of the surface is much better for our purposes. Polyamide gives a smoother surface, that is much better for painting. Applying two layers of primer and paint without sanding is enough.

This is especially true for complex concave products. However, we want to make functional and beautiful products. Such expensive equipment costs from 1 to 2 million rubles, and it is impractical to acquire it ourselves as we simply wouldn’t use it enough to print in such large quantities. At the moment, we are working with some guys from St. Petersburg who print using recycled materials. Unfortunately, we couldn’t find a company in Moscow that would make a product for an adequate cost and within a reasonable time. 150 rubles per gram – this is an incredible price and any prototype would be as expensive as gold. We cannot afford to lose profitability.

At the moment, this is an ideal scheme. On our own, we can quickly produce good quality prototypes and small parts with minimal expenses, and then make finished products by outsourcing their production.

Another example is the prototyping of specialized MRI coils, which are made almost completely on a 3D printer. In principle, no one in Russia is engaged in this, as far as we know there are no companies that would make them, or training in the creation of coils. But there is a need, and not only in our country, but all over the world.

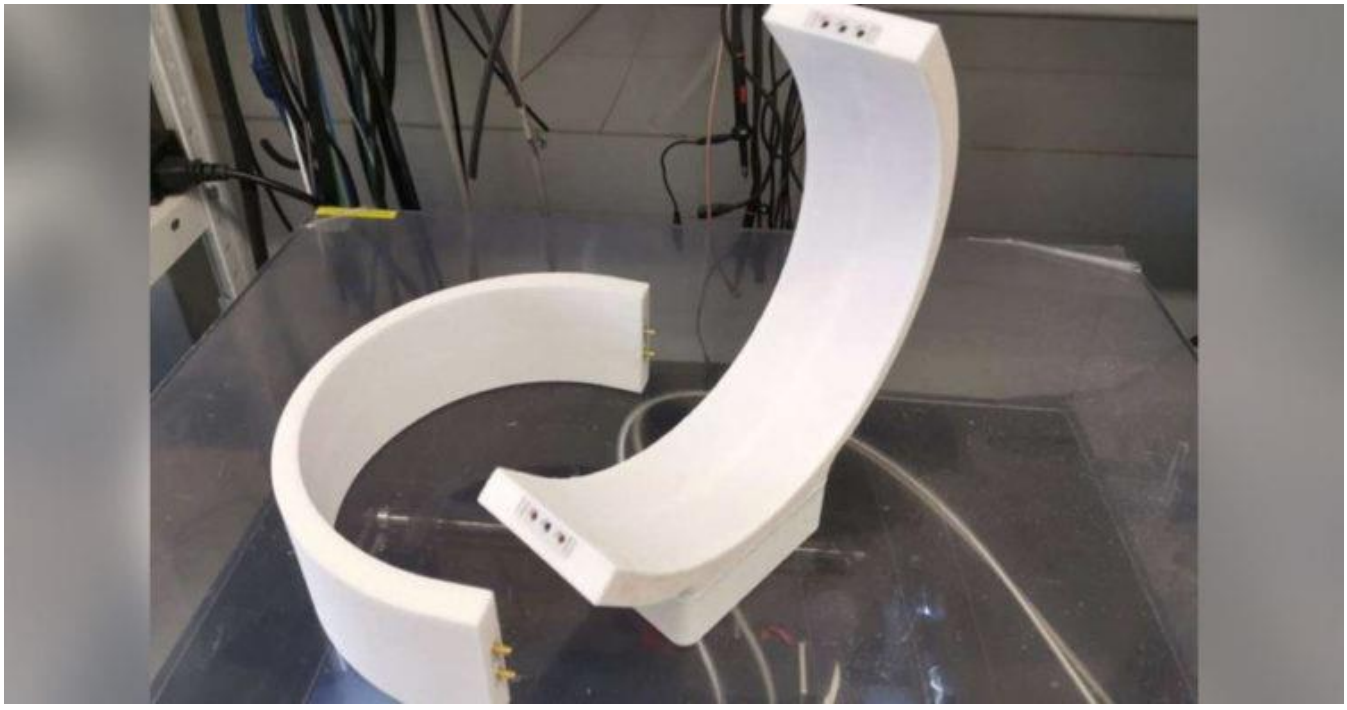


MRI coil printing on Raise3D Pro2 Plus

The MRI coil is a complex arrangement of narrow-band directional antennas that allows you to capture the magnetic resonance signal from the object under study. In fact, it is a measuring device that records the signals of the examined parts of the patient's body.

Just recently, there was an MRI test of such a coil, and within a couple of weeks a prototype of the coil was sewn in leather.

The coils are covered with leather for a more comfortable use – washing and cleaning leather is much easier than other materials.



Printed spool with built-in mount

Leather-coated Coil

3D Printing VS Alternative Production Methods

We used to make experimental models of epoxy resin and fiberglass, with some prototypes sometimes made from papier-mache. Since this is manual work, the repeatability in these cases is very low.

Then, we tried to outsource the necessary prototypes and parts. I tried to find competent people who could help make the models, but, unfortunately, this is either very expensive or takes a long time. In Russia, the price for printing our own model which we personally created in a 3D program is inadequate. I had to study 3D printing myself, and then also 3D milling, since not everything is possible to print from plastic. There are some electrically powered things that need to be made of aluminum or copper. I walked this path myself.

Pros and Cons of 3D Printing

3D printing has colossal advantages. If you have already developed and tested the final prototype, then nothing is required afterwards, just send the STL file for printing on an industrial printer with ideal surface quality.

The disadvantage of FDM printing is that even a layer thickness of 0.1 mm does not make it possible to print finished products in our area. Ideally, you need plastic that is very easy to process and paint, so a sales look can be achieved faster.

And, of course, the printer saves a lot of time in everyday, common moments – from printing a bracket for a projector or a children's game console, to gears for a mincing-machine or other devices. This applies to anything that is either impossible to find or will cost a lot of money. I can sit down, draw for half an hour, print it, and the finished product is in my hands.

Since I print a lot, if I suddenly need, for example, some kind of plug for a pipe, it's easier for me to draw and produce it on a 3D printer. It will be much faster than spending time going out and searching, as

well as spending money on gasoline.

The best part is that thanks to the huge number of clubs and Centers for Youth Innovation Creativity on Robotics and 3D Modelling, the number of which is constantly growing. More and more children are involved in the process, and they are able to model and print on a 3D printer from a young age. Children can already 3D print a quadcopter. My employee, who has been in this area for a long time, can draw a model during the day, put it on print, leave, and in the morning have the finished product ready. This will very quickly and qualitatively improve the processes of inventions in the near future.

Connect with Raise3D

Do you have a great 3D printing success story and think it would be cool to be featured on www.raise3d.com, we would love to learn more! Write to us at inquiry@raise3d.com

For more information about Raise3D printers and services, browse our website, or schedule a demo with one of our 3D printing experts.