



DOCENCIA

RAPID PROTOTYPING. TECHNOLOGY AT SERVICE OF HEALTH.

PROTOTIPADO RÁPIDO. LA TECNOLOGÍA AL SERVICIO DE LA SALUD

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SUMMARY

We can summarize that rapid prototyping is one more of the technology advances applicated to the health sciences field. The manufacture of high precision anatomic models from scans give to the health sciences professionals a very value information for the diagnosis, therapy or teach purposes. The visual and touching information give us data impossible to obtain by other methods, and this is in fact the most important thing that the rapid prototyping techniques offer us.

RESUMEN

El prototipado rápido es un ejemplo más de la aplicación de los avances tecnológicos en ciencias de la salud. La obtención de modelos anatómicos muy precisos a partir de escáneres permite una información muy valiosa para el diagnóstico, terapia o fines didácticos. A partir de resonancias magnéticas, escáneres y radiografías obtenemos imágenes de la estructura interna del órgano o miembro que se va a estudiar. Su éxito reside en la información visual y táctil que nos ofrece, la cual, frecuentemente, nos proporciona datos no visibles por otros métodos.

INTRODUCTION

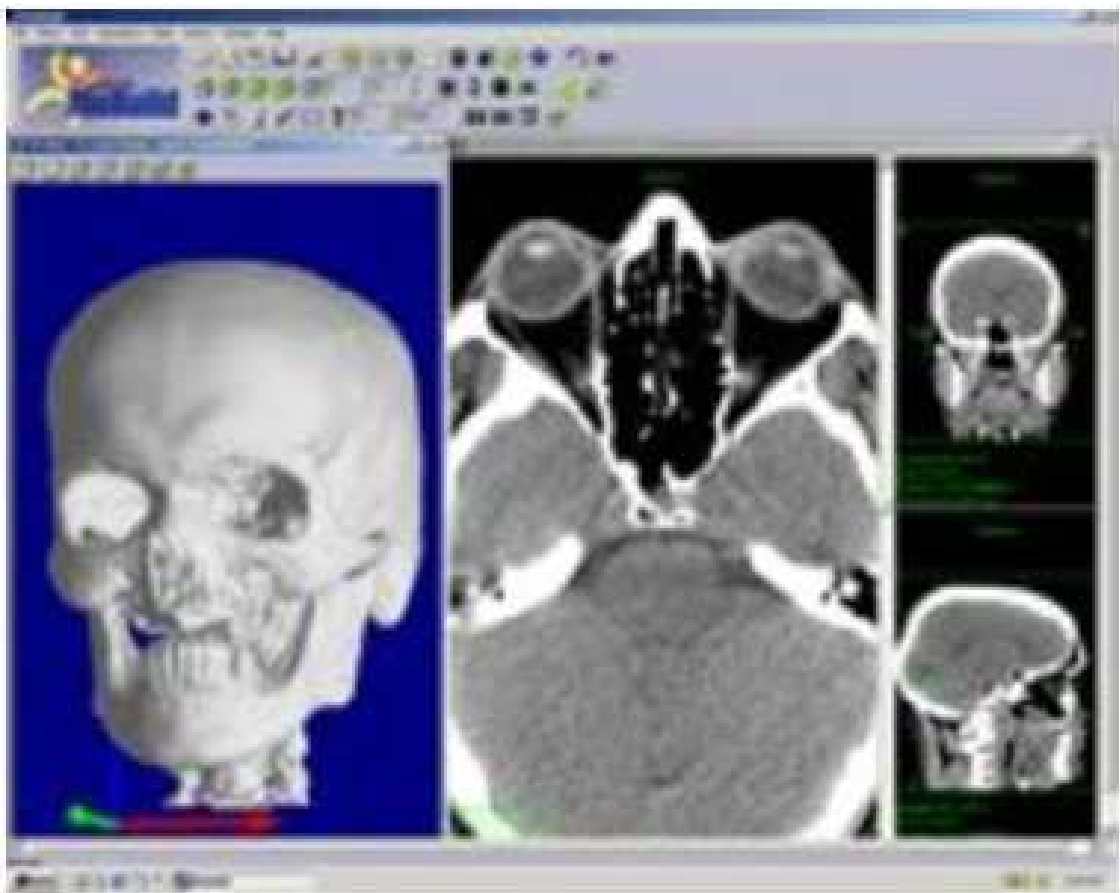
The rapid prototyping is a new technique to build prototypes. With a prototype you can actually see in real life the part which has been design, so this is the physical model of an idea. This technique permits the construction of literally any shape that can be modelled, even shapes that cannot be formed using conventional manufacturing tools and techniques.

The rapid prototyping has meant a revolution in the industrial design world, because everything we can think can be made as a physical model in some hours or minutes, and it improves the products features and the design.

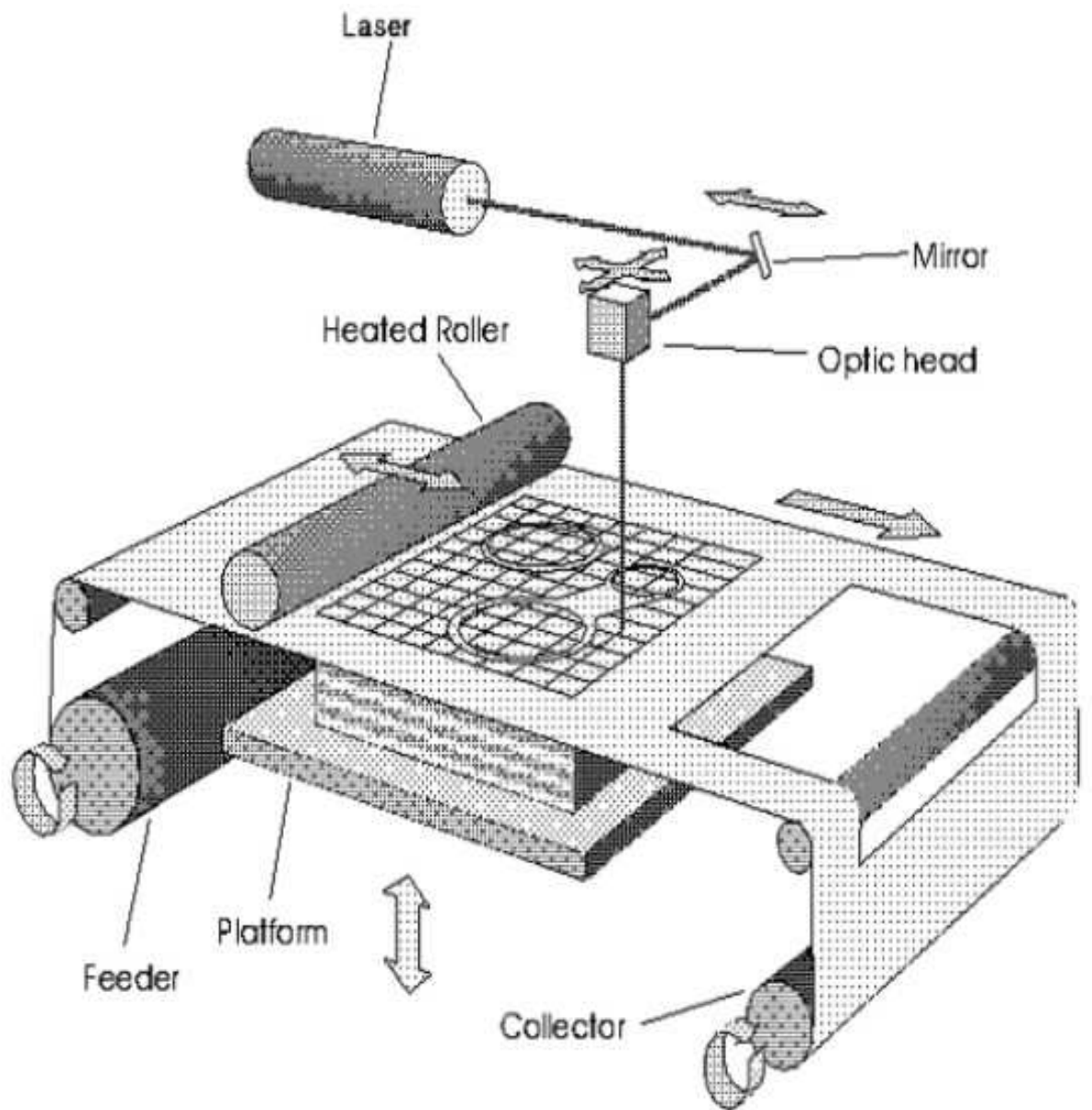
METODOLOGY

The basic methodology is:

- We constructed a model of the part which is going to be manufactured in a computer design programme (a CAD model) and we converse the file of the design to STL format. STL is the kind of file that the rapid prototyping machines recognize (Fig.1).



- The machine processes the STL file by creating sliced layers of the model, like when we slice a piece of cheese (Fig. 2 and 3).

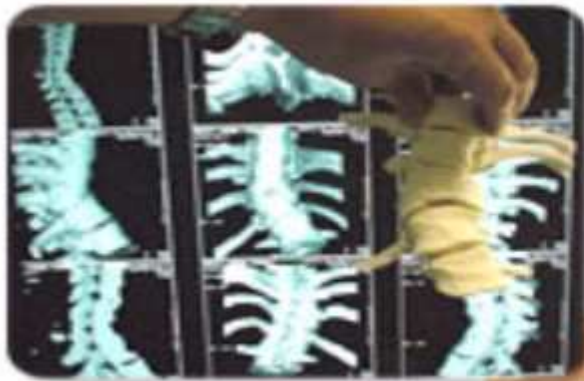




- After the first layer the process is repeated until completion of the model.
- The model and any supports are removed from the machine. The surface of the model is then finished and cleaned.

APPLICATIONS TO HEALTH CARE FIELD

So that, this technology applications are infinite, as wide as our imagination, and in some fields advances are being more helpful, like the health cares field. We can get a high resolution images of internal structures of the human body (bone structure and organs) from magnetic resonances, scanners and radiography from the patient. Once these images are processed by suitable software tools, it is possible to transfer the results to a rapid prototyping process and obtain a physical part. These are the medical models (Fig. 4 and 5).



These models are very useful to preparing complex surgeries and very helpful to carrying out these surgeries successfully. The health care professionals have a real size physical part of the patient pathology region in order to analyze and evaluate the problem complexity before the surgery. It reduces the duration of the surgery, minimizes the risks and the patient suffering too.

An example of the application of this technique in the preparation of a surgery took place in Australia, in the Holy Spirit Hospital of Brisbane. The Dr. Geoff Askin used rapid prototyping to obtain more information about a Neurofibromatosis case. Doctors requested a biomodel for advancing planning the complex surgery required. An spiral scan clearly showed a gross cervicothoracic deformity, caused by congenital disease.

Another example of surgeries planned using rapid prototyping medical models are the implants. In this case the model could be directly the mould for manufacture the part which is going to be implant (Fig. 6).



In the most of the cases of surgeries simulations the time of model manufacture (just some hours or minutes) is the most interesting aspect of this technique.

But there are much more applications of rapid prototyping in this area: diagnosis, implants, communication, dental area, forensic analysis, etc. Other applications are the paleontology or the early detection of natal deformities.

Sometimes, patients with unusual medical deformities are refused to donate their bodies and, when they do it, they have often been operated on disturbing the anatomy of interest.

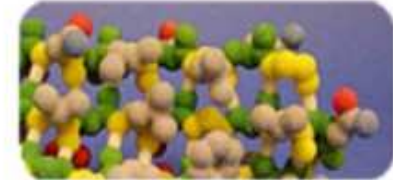
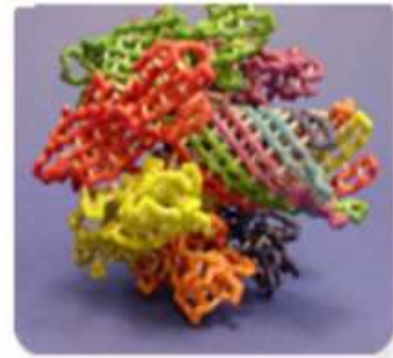
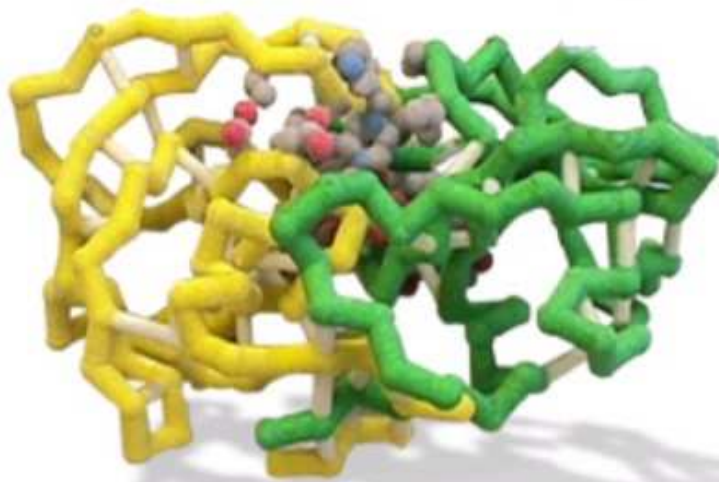
Rapid Prototyping models allow multiple copies of the deformity to be replicated and distributed. Thanks of these models the deformities will be able to be studied and will be useful to show to students.

The rapid prototyping has also application in the forensic analysis field. Thanks of the prototype, they preserve the original as evidence and then, they rebuilt the facial region and created a composite sketch (Fig. 7).



Another very new and interesting application area for RPT inside medical applications is the manufacture of Chromosomes and viruses. A good example is the study of Chromosomes carried through by Dr. Peter Engelhardt, from the Department of Virology , Helsinki University of Technology. At first, he prepared the chromosome for a picture session. This includes introducing markers that were used as reference points for the 3D reconstruction (Fig. 8). The photographs were then used for constructing a 3D CAD model of the chromosome.

Then it was converted in to a STL format at the Center for Scientific Computing. This file divides the picture in triangles and in this case it contained more than 700000 triangles and was then processed at the Institute of Industrial Automation using software tools developed there. The only Rapid Prototyping process that has the required software tools is the SOLIDER process from Cubital.



Chromosomes are extremely complex, therefore several visualization techniques are used to understand their structure, one of them is the rapid prototyping, which allows us to have a physical model of the chromosome.

Another project of the rapid prototyping in the field of health sciences was the one carried out by the Technology University of Tampere in 2002. This was a project of the Mechanical Department for the Tampere University Hospital (Pirkanmaan Sairaanhoidopiiri). The patient suffered a deformity in his jaw, therefore, a prosthesis was going to be implanted in the jaw by a complex surgical operation. Using radiographies and magnetic resonances, the rapid prototyping machine made a model of the jaw of the patient which was used after to manufacture the prosthesis.

CONCLUSION

We can summarize that rapid prototyping is one more of the technology advances applied to the health sciences field. The manufacture of high precision anatomic models from scans give to the health sciences professionals a very valuable information for the diagnosis, therapy or teaching purposes. The visual and touching information give us data impossible to obtain by other methods, and this is in fact the most important thing that the rapid prototyping techniques offer us. .

The future of this technique is very hopeful, because it has the possibility of being applied in whatever field we imagine, one of these is the health sciences field. This is one of the fields where the rapid prototyping advances are more interesting. In the future it will be easy to have a prototype of any part of the body before a surgery or before studying illness not very common. It will be also very useful in laboratories

ANALYSIS OF THE LITERATURE

1. www.caip.rutgers.edu: Centre of Advanced Information Processing (CAIP) supported by New Jersey Commission on Science and Technology, Rutgers University and industry membership. Here there are two parts very interesting. One of them speaks about computer aided desing and layered manufacturing, and the other about biomedical engineering.
2. www.deskartes.fi: DeskArtes is a company wich provides 3D Industrial Design Software, and Value Adding Software Technology for rapid prototyping, simulation, data verification and data healing. DeskArtes was founded in 1989 as a continuation on research projects started already in 1985 at the Helsinki University of Technology.
3. www.efunda.com: Efundas is a place in internet for the engineering community. In its website we find a lot of information about rapid prototyping and its applications.
4. www.garpa.org: Global Alliance of Rapid Prototyping Associations (GARPA). In this web we can find explanation about rapid prototyping and manufacturing around the world.
5. www.hut.fi: Web page of the Helsinki University of Technology.
6. www.ita.es: Instituto Tecnológico de Aragón (Goberment of Aragon). This institute has a rapid prototyping machine which is used for making moulds.
7. www.tut.fi : This is the web of the Technologic University of Tampere.
8. www.rpworld.net: Rapid Prototyping Service Provider.
9. www.zcorp.com: Z Corporation is one of the most important and advanced companies in the world in rapid manufacturing. It has created the serie of machines Z Printer. This is one of the techniques within rapid prototyping.

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