Freedom of Creation Lighting Objects Using Rapid Prototyping

Antero Cunha[1,a], Humberto Macedo[1,b] F. Jorge Lino[2,c] Pedro V. Vasconcelos[1,d] and Rui J. L. Neto[3,e]

[1]UIDM, ESTG, Instituto Politécnico de Viana do Castelo, Ap. 574, 4900-348 Viana do Castelo, Portugal

[2]FEUP, Faculdade de Engenharia da Universidade do Porto, R. Dr. Roberto Frias, 4200-465 Porto, Portugal

[3]INEGI, Instituto de Engenharia Mecânica e Gestão Industrial, R. Barroco 174, 4465-591 Leça do Balio, Portugal

[a]vortexglider@hotmail.com, [b]doisbertos@hotmail.com, [c]falves@fe.up.pt, [d]pedrovasco@vxpt.com, [e]cetecoff@inegi.up.pt

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Abstract. RP technologies allow the manufacture of prototypes that can be used as concept, functional or technical models. These prototypes are a precious support for new products development. Nowadays, Rapid Prototyping (RP) technologies are considered more mature, and the Rapid Manufacturing (RM) concept is becoming progressively more reliable and employed in different areas. RM is also an additive process that creates directly the final product without the need of production tools.
Two Product Design students, during their training in INEGI, developed 3 original lamps to illustrate the potentialities, in terms of freedom of creation and manufacturing speed, of using these technologies. Different RP processes, LOM, SLA and SLS, were employed to illustrate possibilities to directly create personalized final products. The RP equipments are presently available in Portugal and can be used by particulars or companies that need to develop new products.

Introduction

Rapid Manufacturing (RM) is an additive process that includes the principles of RP [1], and has been presently used to manufacture final products, eliminating the need for tooling set up, with the products being directly used after finished in the machine [2, 3].
Two finalist's students of an HSc Product Design course, in the scope of a project to create an interactive CD about product development, illustrated the RP and RM processes by the creation of 3 lighting objects (Fig. 1), using the RP equipments installed in INEGI and CENTIMFE (Technological Centre for Moulds, Special Tools and Plastics Industry). From different purposes, the three following products were selected:
- Solar energy powered garden lamp (with leds), composed by parts produced by LOM (Laminated Object Manufacturing) and SLA (Stereolitography) [4, 5];
- Interior lamp to place on a table, produced by SLS;
- Interior lamp with a support in steel, produced by SLA (Stereolitography) [6].

Design innovative objects, supported by the knowledge of the potentialities and limitations of the new RP and RM technologies, is an added value to better explore shapes and materials capacities.

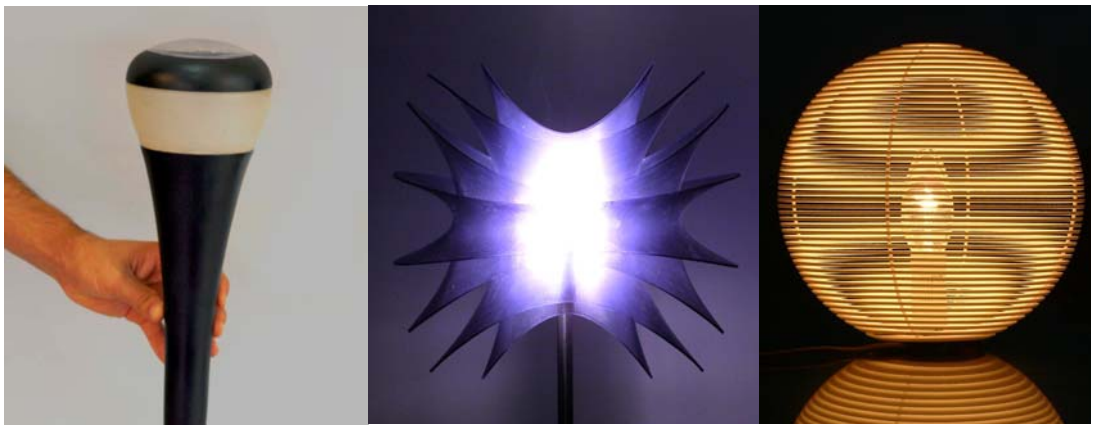


Fig. 1 Lamps for different applications manufactured using different rapid prototyping equipments.

Solar powered led lighting project (Fig. 2). The aim of the solar powered led lighting project was to produce inexpensive objects with an environmental concern and based on the exploration of the potentialities of the new technologies.

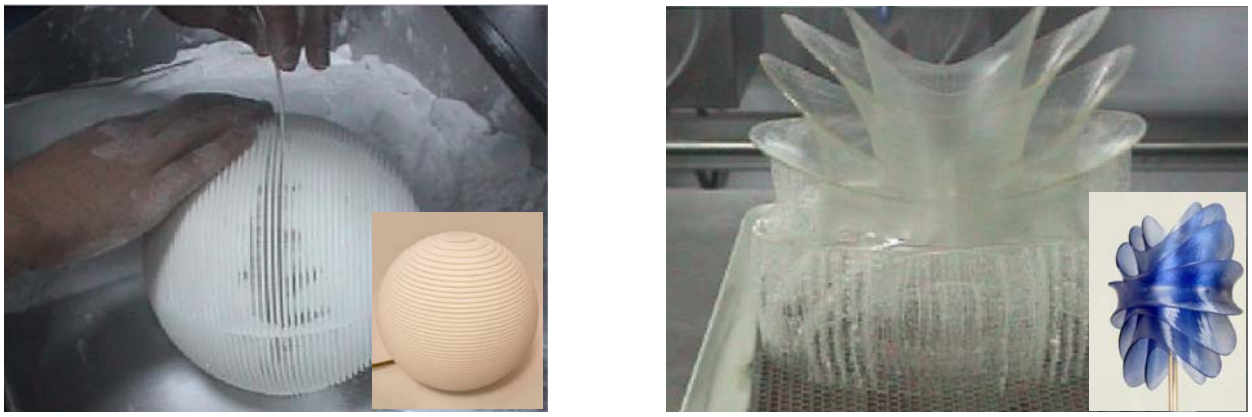
The lighting system must be produced by injection moulding of a polymeric material. The formal concept of the lamp is based on natural elements, as the mushroom shape and the soft light of the glow worm. At the formal level, it was tried to develop a product with low impact in the surrounding environment, a simple appearance, and a shape that was appropriated to resist to all weather conditions (for example, no water accumulation).

The lighting body is divided in two main parts, the base and the top. After developing the lamp shape concept, two RP technologies were selected for the prototype production. Due to the complexity and thickness of the top component, the SLA technology was considered the best process. For the base that is characterized by a simple and thick geometry, the LOM technology was the most adequate process due to economic reasons and dimensional restrictions of the RP machines. The two components were finished by manual polishing, sealing and painting, and later all the parts were joined and glued, to obtain a functional prototype.

Fig. 2 Solar led lighting produced by SLA and LOM.

The electric system employed is a typical system available in the market that is composed by a common solar panel, with a rechargeable battery and led (standard for this type of applications).

Interior lighting projects produced by SLS and SLA (Figs. 3 and 4): The idea was the creation of objects that could explore shapes limits of the RP technologies capacities, to demonstrate the respective potentialities for new products development. At a formal level, it was intended to create products that due to its shape complexity, material properties and costs, the RP technologies were the unique alternative.



(a) (b)

Fig. 3 Lighting objects produced by: (a) SLS and (b) SLA.

The lighting objects, frequently exhibit an aesthetic and artistic dimension that allow its direct manufacture by RM, with exclusiveness characteristics and high added value. Some objects stand out, as the ones produced by MGX Company - Materialise, pioneer in the production of this kind of products. This company did a similar proposal to designers with the objective of promoting and commercializing RP and RM artefacts, for instance; "Lily.mgx" of Janne Kyttanen, produced in SLS, winner of Red Dot Award 2006, and "Opencube" of Jiri Evenhuis, produced in SLA (www.materialise-MGX.com).

The SLS lamp is a spherical globe constituted by rings equally spaced that explores the projection of light effects on the surrounding atmosphere.

Although it highlights a simple geometry, the fact is that, from a production point of view that is not true, due to the high technological difficulties to manufacture the concentric rings with such small distances among them, as well as the respective connection features. Although it was possible to produce them by conventional production methods, the charm that this piece exhibits would not be the same. The lamp can assume multiple functionalities, with different lighting options, like in a table, ceiling or wall version, starting from the same basic body, what naturally is commercially advantageous.

Once selected the final version from the different student's proposals, Centimfe accepted to produce the part by the SLS technology.

The project was evaluated and minor corrections were performed to match the specific capacities and limits imposed by the SLS machine (DTM ST 2500), namely the construction material, the maximum dimensions and orientation, and the minimum thickness of the part, among others.

After finishing operations, a standard electric system was connected to the part.

The other lamp was obtained by SLA, and is an organic shape, based in flowing lines and vegetable structures. It is composed by four features that fit inside each other, with the particularity that they can not be mounted or removed as isolated parts, once the outer diameter of the parts is larger than their central diameter (Fig. 4).

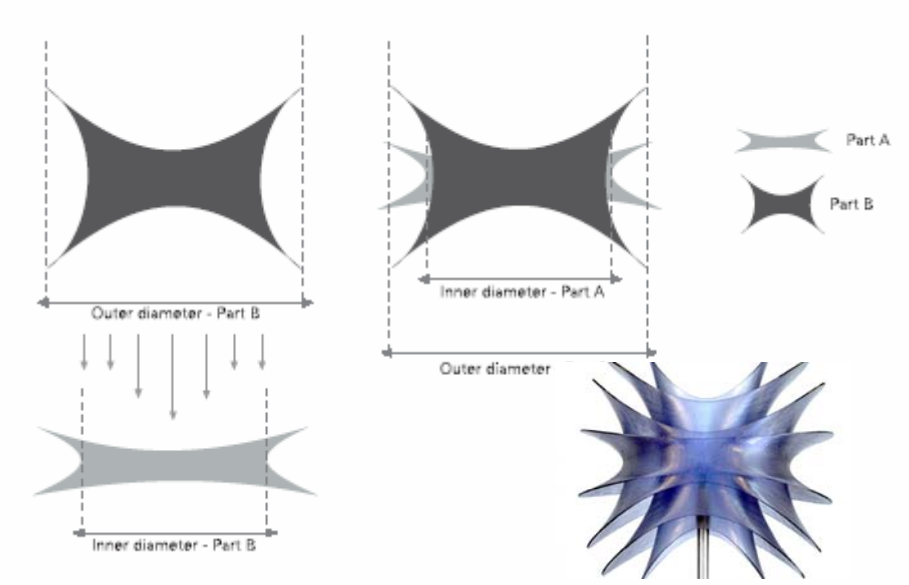


Fig. 4. Interior lighting system produced by SLA, showing the shape complexity, composed by concentric rings that are impossible to assemble as singular parts.

It was planned to supply a diffuse illumination, creating an environment light not advised for reading or work, but appropriated for a quite social atmosphere. When the part was concluded, a blue translucent colour was chosen, however it is possible to finish the prototype with different colours, using different types of pigments during the SLA models finishing.

Conclusions

Like rapid prototyping, rapid manufacturing eliminates the need for tooling set up, with the possibility to directly create parts of intricate geometry to be applied in personalized final products. The three projects presented in this paper illustrate the potentialities of using these technologies with a complete freedom of creation and manufacturing speed, reducing the time-to-market.

The ability to create new parts, quickly and without the delays of the traditional manufacturing processes, which demand moulds and other tools, allows the companies to produce rapidly single parts or short series, and introduce more challenging and personalized products in the market.

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