# BolusVisionOnline: 3D Soft Bolus Printing Utilizing Eclipse Scripting API (ESAPI)

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## INTRODUCTION

Our institution started using 3D printing technology to generate soft bolus in 2016. The bolus is made from soft material, silicone gel, to conform to patient skin for comfort. The mold is created as two rigid pieces, which are glued together for casting the soft bolus. The purpose of two pieces is for easy removing the bolus from the mold. It is impossible to remove the bolus out of the mold if the mold is just one rigid piece.

We developed a software four years ago to solve the problem using MATLAB. However, it requires exported DICOM files and the mold pieces are not split very well, the parting lines between the two pieces contain a lot of zig-zag shapes. Therefore, we developed an ESAPI script, called BolusVisionOnline, to eliminate the step of exporting structure DICOM files and to split the bolus with smoother parting lines.

## METHOD

BolusVisionOnline is an ESAPI script that automates the mold generating and printing process by the following steps.

(1) A new structure is created by expanding the 3D bolus structure by 5 mm to all directions.
(2) The bolus structure is subtracted from the expanded bolus to generate the mold structure.
(3) The contours of the mold structure are removed from those image planes where there is no contour for the bolus so there are openings on both top and bottom of the mold for pouring in silicone gel.
(4) An AND Boolean operation is performed between the mold and BODY structure to generate the first mold piece structure.
(5) The first mold piece structure is subtracted from the mold to generate the second mold piece structure.
(6) Two STL files for the mold piece structures are generated for 3D printing.

## RESULTS



Figure 1. Structures in Eclipse. (a) A bolus. (b) The bolus is sandwiched between two mold pieces.



Figure 2. The ESAPI script prints mesh metric information and STL file generation results in a console windows.
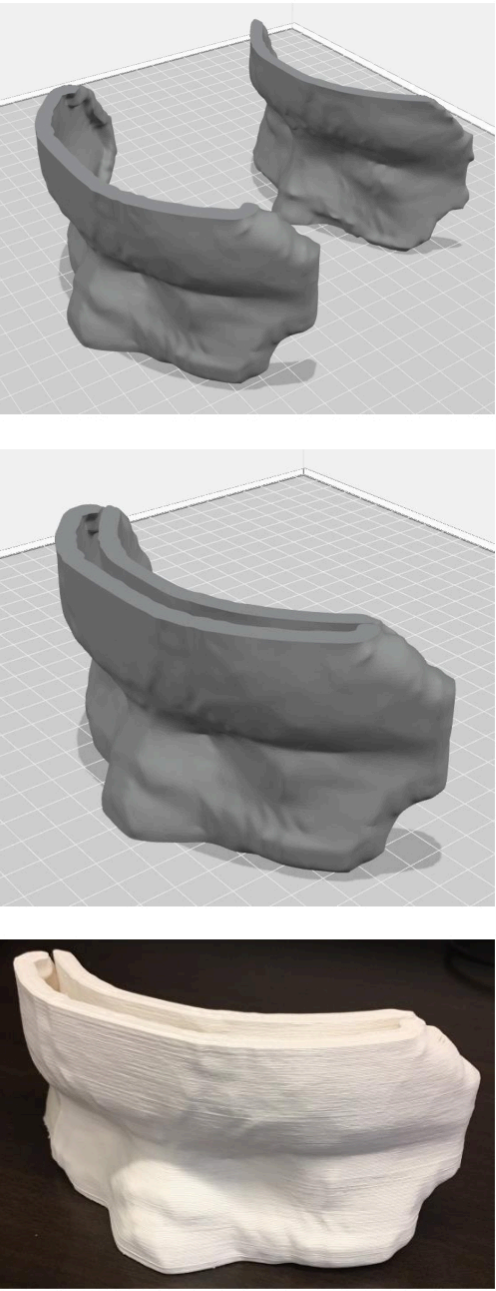


Figure 3. (a) Two mold pieces are shown separately in 3D printer software.
(b) The 3D soft bolus will be casted by pouring silicone gel in the mold when two pieces are glued together.
(c) The printed mold pieces.

## CONCLUSIONS

BolusVisionOnline is still in its testing phase. Compared to its predecessor developed using MATLAB, it

(1) eliminates the need of exporting structure DICOM files,

(2) runs as a script in Eclipse so there is no need to install another software and any supporting program libraries,

(3) creates mold piece structures and generates STL files in only two seconds. Figure 2 shows how the mold pieces look in 3D printer software.

In summary, an ESAPI script has been developed for improving automated 3D bolus mold printing process by utilizing some build-in features of ESAPI data structures.

Compared to its predecessor developed in MATLAB, BolusVisionOnline can be run in Eclipse to generate mold STL files more efficiently.

## CONTACT

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