Do not capitalize your short-paper title

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Abstract: Place a brief summary of your work here. Do not use more than 100 words. 3D printing is of outstanding importance in medical engineering and has been growing continuously in recent years. From prostheses and soft implants to matrices for tissue engineering, additive manufacturing has decisive advantages for medicine. The scientific conference AMMM 2019 brings together engineers, scientists and technicians with physicians and entrepreneurs to discuss the latest achievements in 3D printing development for medicine.

# I. Introduction

Two section headers should not follow each other directly without textual content.

## I.I. Subsection

Your paper should have not more than two pages. The template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them. Do not squeeze more text into the limited number of pages. Use only the formats defined for this document.

Number equations consecutively with equation numbers inparentheses flush with the right margin, as in (1). Use parenthesesto avoid ambiguities in denominators. Punctuate equationswhen they are part of a sentence, as in

(1)

Please note that the book of abstracts will be black and white. Make sure figures are still legible. Fig. 1 is an example for a black and white figure.

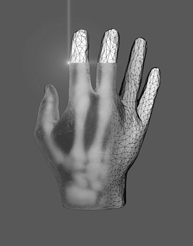


Figure 1: Please use grey-scale images only. It is good practice to explain the significance of the figure in the caption. Each figure should be able to be standing alone.

Do not put borders around your figures. Each figure/table should be mentioned in the text.

Use the abbreviation “Fig.” throughout the text of your abstract, even at the beginning of a sentence.

Figure axis labels are often a source of confusion. Use words rather than symbols. As an example, write the quantity “Energy” or “Energy, E” not just “E”. Separate units with a slash, e.g. “Energy / J” or “Energy in J”. Do not label axes only with units.

## I.II. Second subsection, if necessary

To provide consistent reproducibility, please include axes and tick marks on all four sides of your graphs and avoid the use of grid lines (note that grid lines tend to clutter a graph if dark or reproduce poorly if light). Please also include an explanatory legend within your graphs when two or more curves or sets of data are included. Avoid explaining the different symbols and curves in the figure caption alone - using a legend results in a much more easily understood figure. Do not abbreviate “Table”. Tables are numbered with Arabic numerals, as can be seen in Table 1.

# II. Material and methods

We used Houdini FX, a VFX software traditionally used in the film and games industries to create a process for rapidly segmenting airways from patient geometry, finding the average path through that airway, then using that data to procedurally design a laryngoscope that is sized to perfectly fit the patient it has been designed for. This process starts with importing patient data, which can be created using any software (including Houdini with our customized DICOM toolset built for Houdini). Next, the data can be segmented inside of Houdini to isolate the negative space of the patient’s airway. After that a solver is ran to determine the path and width of the airway, before finally extruding the tool along the toolpath created from the patient data, and fabricating the new device using 3D printing technologies. Figure 1, below, shows this process broken into several distinct parts, for importing patient data, refining patient data, finding a close bounding shape, segmenting the airway from the rest of the patient data, finding the center line, which can be exported for use in other cad software, or applied to the tool profile in Houdini to create a device.

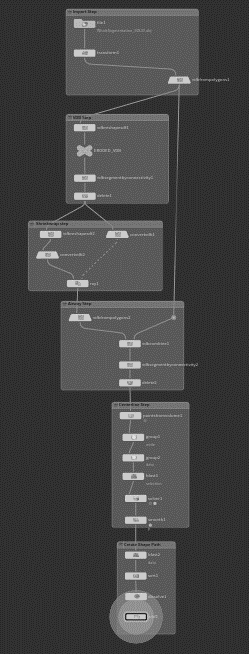


Figure 1: Houdini network graph showing the process of finding the airway center line

## II.I. Patient Data

The raw patient data should be geometry of the tissue and bone in the patient, leaving the airway of the patient hollow. In most segmentation software, this is a simple task, and can even be done in Houdini, using our custom segmentation software, to avoid using different software.

## II.II. Segmentation

The segmentation step involves creating a shell around the base geometry, using a shrink-wrap operation, and then using a subtraction operation to cut the source patient geometry from the shell geometry. This will leave the airway, and any other empty space inside of the patient data geometry, allowing easy removal of the disconnected parts, leaving only the negative space of the airway.

## II.III. Pathfinding

After the airway volume has been segmented, there are two options for finding its center path, one being the use of a modified space colonization algorithm, and the other using Houdini’s native find shortest path node.

The space colonization method, takes an input point near the front of the volume, where the mouth would be, and using a point cloud defined inside of the airway’s volume to organically grow a path through the airway, which can be averaged to find a close approximation of the curvature of the airway.

The other option is to select a group of points at the mouth, and another group at the end of the airway, and to use find the shortest path between the two groups using a point cloud similar to the one used for space colonization method, and averaging the paths to find a centerline.

## II.IV. Part Design

Using the airway path designed above, you can extrude and loft a tool shape along this path to create a laryngoscope that will follow the path of the airway, and can be easily and quickly customized to any patient.

## II.V. Fabrication

Since this part was designed in a digital space, it can be easily exported for creation on a 3D printer. This methodology would allow for the rapid creation of one-time-use medical devices that could be designed on an as needed basis for patients as they enter a hospital with minimal wait time.

# III. Results and discussion

Some common mistakes:

* The word “data” is plural, not singular.
* The subscript for the permeability of vacuum **0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
* In American English, commas, semi-/colons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
* A graph within a graph is an “inset”, not an “insert”. The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).
* Do not use the word “essentially” to mean “approximately” or “effectively”.
* In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.
* Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
* Do not confuse “imply” and “infer”.
* The prefix “non” is not a word; it should be joined to the word it modifies, usually without a hyphen.
* There is no period after the “et” in the Latin abbreviation “et al.”.
* The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

# IV. Conclusions

Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

### Acknowledgments

##### The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression, “One of us (R. B. G.) thanks . . .” Instead, try “R. B. G. thanks”.

### Author’s statement

##### Research funding: The author state no funding involved. Conflict of interest: Authors state no conflict of interest. Informed consent: Informed consent has been obtained from all individuals included in this study. Ethical approval: The research related to human use complies with all the relevant national regulations, institutional policies and was performed in accordance with the tenets of the Helsinki Declaration, and has been approved by the authors’ institutional review board or equivalent committee.

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