Novel Approach for Quantification of Pore-size for Scaffolds (>16 cm^2) Using ImageJ Software for Quality Control

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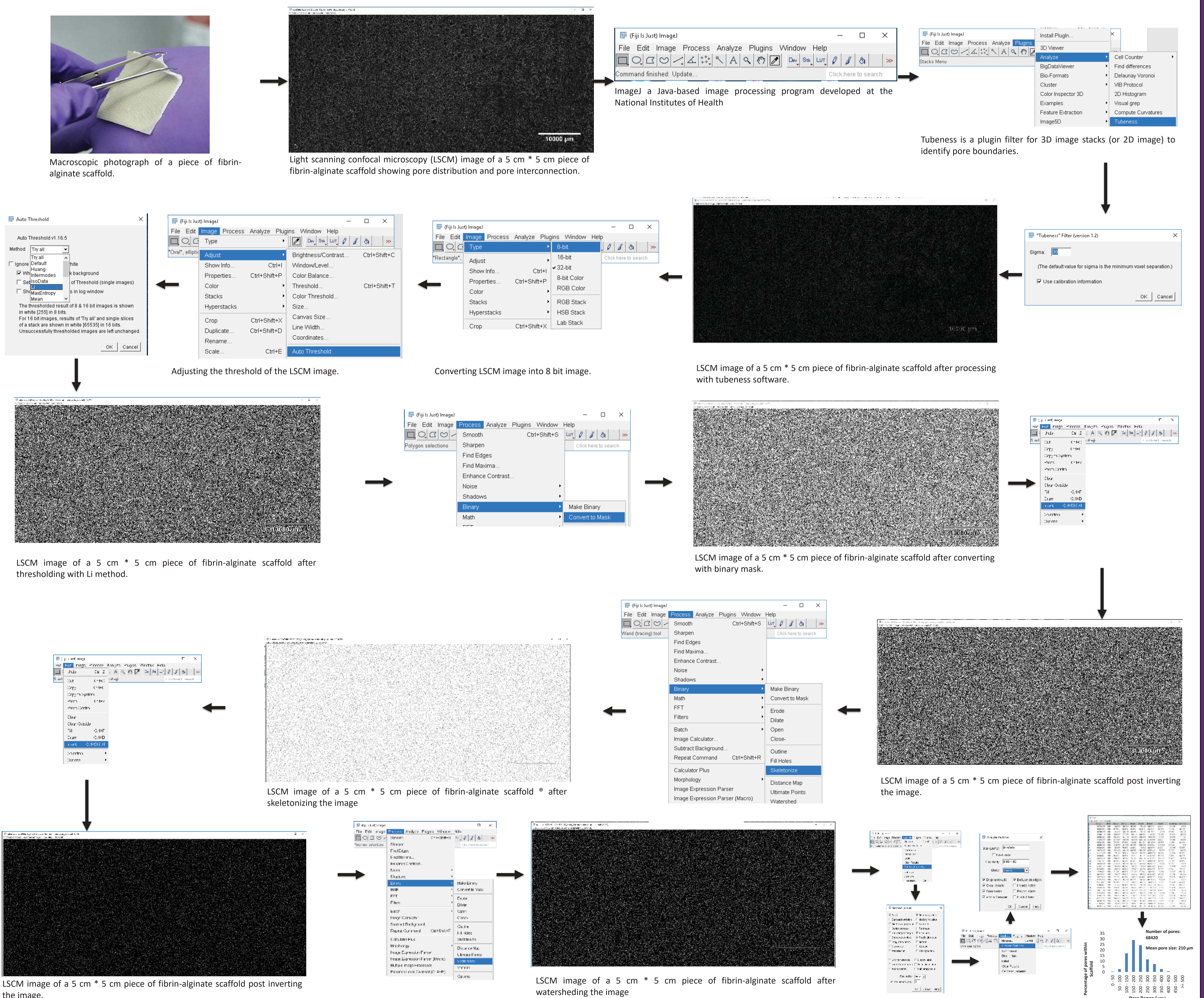[2]Smart Matrix Ltd, Leopold Muller Building, Mount Vernon Hospital, Northwood, HA6 2RN, United Kingdom.
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Introduction: Computerised softwares available to quantify the microstructure of biomaterials include MATLAB, ICY, Avizo, Image Pro and others. However, these techniques are only used to quantify pore sizes over small sample areas with a homogenous pore structure. However, as the size of the biomaterials increases (area>4 cm^2) and the pore distribution becomes gradient the analysis becomes more difficult.

Aim: To establish a method using ImageJ software to quantify pore size distribution in materials with gradient porosity distributed over an area of 1 – 100 cm^2

Method & Results

Macroscopic photograph of a piece of fibrin-alginate scaffold.

Light scanning confocal microscopy (LSCM) image of a 5 cm * 5 cm piece of fibrin-alginate scaffold showing pore distribution and pore interconnection.

ImageJ a Java-based image processing program developed at the National Institutes of Health

Tubeness is a plugin filter for 3D image stacks (or 2D image) to identify pore boundaries.

Adjusting the threshold of the LSCM image.

Converting LSCM image into 8 bit image.

LSCM image of a 5 cm * 5 cm piece of fibrin-alginate scaffold after processing with tubeness software.

LSCM image of a 5 cm * 5 cm piece of fibrin-alginate scaffold after thresholding with Li method.

LSCM image of a 5 cm * 5 cm piece of fibrin-alginate scaffold after converting with binary mask.

LSCM image of a 5 cm * 5 cm piece of fibrin-alginate scaffold * after skeletonizing the image

LSCM image of a 5 cm * 5 cm piece of fibrin-alginate scaffold post inverting the image.

LSCM image of a 5 cm * 5 cm piece of fibrin-alginate scaffold post inverting the image.

LSCM image of a 5 cm * 5 cm piece of fibrin-alginate scaffold after watersheding the image

Conclusion
- Using this method, pore distribution of a fibrin-alginate scaffold (49 cm2 > 1x108 pixels) was quantified within three minutes on a standard PC and measured over 227,000 pores..
- Such tools offer potential of repeatability and effectiveness in data quantification which will be valuable for quality control during biomaterial manufacturing processes.

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