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DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

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## THREE DIMENSIONAL QUANTIFICATION AND FLOW SIMULATION OF DEPTH AND MEMBRANE FILTER STRUCTURES BASED ON HIGH RESOLUTION X RAY IMAGING



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### ABSTRACT

High resolution 3D imaging has been applied to produce detailed representations of membrane and depth filter materials to analyse geometric characteristics and simulate flow through porous networks. Four depth filters and five membrane filters were selected for respective micrometre and nanometre scale imaging using X-ray computed tomography, enabling visual and quantitative comparisons between materials and to established literature values using non-imaging techniques to validate accuracy of 3D datasets acquired.

Average pore size was the main basis of comparison to vendor-provided nominal retention, with other parameters such as porosity and surface area to volume ratio also evaluated. Variation within and between the separation materials was also of interest, in particular the interface between the separation and support layers within a membrane that can also be symmetric or asymmetric. 3D simulation was also performed on these structures to quantify permeability and tortuosity through these materials to identify flow characteristics that could be related to confocal microscopy findings for both depth and membrane filters.

This study enabled nanometre scale locational comparison within and between filtration structures that enhances understanding of the degree of heterogeneity and how geometrical characteristics inside of membrane and depth filters are linked to function and performance.

### BIOGRAPHY

Daniel G. Bracewell is Professor of Bioprocess Analysis at the UCL Department of Biochemical Engineering. He has made major contributions to the fundamental understanding of biopharmaceutical purification operations, including collaborations with Thailand, India and the USA. He has authored more than 90 peer reviewed journal articles in the area to date and currently supervises 15 doctoral and postdoctoral projects, many of these studies are in collaboration with industry. One such project was the basis from which the spinout Puridify a nanofibre absorption technology company was created. He is academic lead for the UCL-Pall Biotech Centre of Excellence.