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A Method for Simulating Fluid Flow through Heterogeneous Porous Media

Computational fluid dynamics (CFD) modeling of fluid flow through porous media is resource intensive and available macro (and micro) scale models are based on simplifications which significantly impact the accuracy of simulation results. Moreover, current approaches are mostly based on homogeneity assumption and heterogeneity of the medium is often disregarded. This is due to the limitations in finding position dependent macro scale quantities such as porosity and permeability. Since the mentioned quantities change throughout the domain, one would need to define a 3D field which accurately represents the medium. However, finding a position dependent field of porosity and permeability can be a very cumbersome task. Thus, here is a need for better modeling methods and systems which provide greater flexibility, accuracy and speed in fluid flow modeling.

Researchers at Arizona State University have developed a novel method for modeling fluid flow through porous media. This approach is applicable to situations where fluid dynamic simulations are required in a relatively short amount of time for a model including a porous medium. This modeling method delivers a heterogeneous 3D field of porosity and permeability for a porous medium and has demonstrated increased speed and accuracy in a flexible and easy to use platform. The main input for the code for this method would be a surface mesh model of the medium such as an STL file, which most commercially available CAD software packages are capable of generating.

This invention provides an approach in simulating heterogeneous porous media with reduced computational time needed and achieves accurate results in a relatively short amount of time.

Potential Applications

- Healthcare
  - Modeling blood flow through porous endovascular devices
  - Modeling blood flow in choriocapillaries in the eye
  - Modeling fluid flow through fibrous materials such as napkins, diapers, etc.
- Oil and gas industry

- Modeling fluid flow through rocks
- Modeling carbon sequestration
- Modeling gas recovery

- Filtration
- Fuel cells

Benefits and Advantages

- Reduces the computational time needed for simulation
- Helps doctors achieve highly accurate results, for modeling blood flow through porous endovascular devices, in a short amount of time
- Can easily define inputs
- Convenient to use
- The main input is a surface mesh model such as an STL file which is commonly used and convenient

For more information about the inventor(s) and their research, please see Dr. Frake's laboratory webpage