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# Automated Glomerular Segmentation Pipeline for 3D MRI

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## Background

Recent studies conclude that a strong correlation exists between the numbers of glomerular in the kidney and renal diseases. These findings generate great interest in accurately counting glomeruli. Traditionally, the glomerulus is counted using histological sections, which have several limitations. First, histology based counting relies on techniques such as acid maceration and dissection, which will destroy the entire kidney, thus it is limited to the organ when studied outside the body. Secondly, histological techniques extrapolate the total number and size of glomeruli from a selected number of histological sections or isolated glomeruli. As a result, the count is an estimate instead of an accurate assessment of the whole kidney. Advances in Magnetic Resonance Imaging (MRI) techniques show promise to visualize the glomeruli with the kidney inside the body. Unfortunately, this process is compromised due to the lack of capable computational tools.

## Invention Description

Researchers at Arizona State University have developed a new, highly efficient framework for automated glomerular segmentation in 3D with the use of an MRI. The framework requires three phases for processing that are called Hessian based multi-Features Clustering (HmFC) and can accomplish the task of measuring glomerular morphology. In the first phase, a Hessian matrix is created for pre-segmentation purposes. In the second phase, features are extracted from the Hessian matrix and are enhanced with domain knowledge and geometric features. Finally, a Variational Bayesian Gaussian Mixture Model is used for the final segmentation. Accurate results are obtained without destroying the kidney. This innovation advances the physician's ability to diagnose and treat renal diseases.

## Potential Applications

- Early detection of renal diseases
- Medical research
- Industrial applications

## Benefits and Advantages

- **Early Diagnosis** – Allows for early diagnosis of renal disease
- **Non-Destructive** – Glomerulus can be counted without damaging the kidney
- **Technologically Compatible** – Framework operates with images from existing MRI equipment