Research on Voxel Based Coupling Analysis for Blood Flow and Wall Interaction Using Image of Medical Treatment

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1 Background and Purpose

There are a lot of people who die of disease of circulatory system in Japan. The disease of circulatory system increases by becoming aged. Therefore, The disease of the circulatory system increases as the society ages.

The disease of the blood vessel in the disease of the circulatory system is known.

It is known a lot of The disease of the blood vessel in the disease of the circulatory system is generated in the part into which the blood stream changes. Therefore, it is thought that a dynamic action on the vessel wall has some influences on the appearance of disease of the blood vessel disease.

Then, the blood vessel shape is restructured with the image for the medical treatment obtained from MRI and CT, and the analysis that uses actual blood vessel shape is done.

This time, Non-structural grid is used in a past technique. Complex blood vessel shape can be expressed by using non-structural grid. But,High knowhow and a lot of advanced resources are needed for grid generation.

Then, The analysis is made handy in using the voxel as an orthogonalization grid.

The blood stream analysis system that uses the voxel data made from the image for the medical treatment directly as a calculation grid is developed. but, the transformation of the blood vessel is not considered. It is thought that the transformation of the vessel wall influences the flow in the flowfield with a soft wall like the blood vessel.

Then, voxel based coupling analysis system for blood flow and wall interaction was used and analyzed.

2 Calculation Technique

The coupling analysis system that uses it by this research consists of four sections of Voxel Generation, Flow Analysis, Structural Analysis, and Transformation of Shape. The analysis is advanced while exchanging the file between four sections.

2.1 Voxel Generation

The voxel data is generated from the slice image. The voxel data generated with this section is used as a calculation grid in the session after this.

2.2 Flow Analysis

The voxel data is used as a calculation grid. An analytical technique used Highly Simplified Marker and Cell (HSMAC) method . Cubic Interpolated Pseudio-particle (CIP) method was applied to the advection phase. The second accuracy center difference was applied to other phase.

2.3 Structural Analysis

The voxel data is used as a calculation grid. The value of the pressure requested by the fluid analysis was used as the outside power to calculate displacement.

2.4 Transformation of Shape

The following expressions were calculated to request brightness the displacement requested by the structure analysis is used.

$$\frac{\partial B}{\partial t} + D_x \frac{\partial B}{\partial x} + D_y \frac{\partial B}{\partial y} + D_z \frac{\partial B}{\partial z} = 0 \tag{1}$$

B : BrightnessΓ

D_x, D_y, D_z : Displaced speed

3 Conclusion

Elbow and Coronary Arteries with Coarctation ware analyzed.

The tendency as which the Reynolds number is the same by 300 and 500 is shown. but, The change of 500 is a little earlier though 300 of the amounts of the change is larger.