

PIV 3 가
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Visualization of Three-Dimensional Pulsatile Flow in a Branching Model using the High-Resolution PIV System

Hyung-Woon Roh[†], Sang-Ho Suh^{*}, and Jin-Yong Choi^{*}

Key Words: Three-Dimensional Pulsatile Flow(3), Branching Model(), High-Resoultion PIV System(PIV)

Abstract

The objective of the present study was to visualize the pulsatile flow field in a branching model by using the high-resolution PIV system. A bifurcated flow system was built for the experiments in the pulsatile flow. Harvard pulsatile pump was used to generate the pulsatile velocity waveforms. Conifer powder as the tracing particles was added to water to visualize the flow fields. Two consecutive particle images at several cross sections of the flow filed were captured by the CCD cameras (1K*1K and 640*480). The results after the image processing clearly showed the recirculation zones and the formation of the paired secondary flows from the distal to the apex in the bifurcated model. The results also indicated that the flow velocities in the inner wall moved faster than those in the outer wall due to the inertial force effects and the helical motions generated in the branch flows as the flow proceeded toward the outer wall. While the PIV images from the 1K*1K camera were closer to the simulation results thantheimagesfromthe640*480camera,bothresultsofthePIVexperimentsusingthetwo camerasgenerallyagreed quitewellwiththeresultsfromthenumericalsimulation.

1. 3 가 가 , 가

(acherosclerosis) , 가 (scale) . 3 3 가

† E-mail : rohlee@yahoo.com
TEL : (02)824-0658 FAX : (02)821-6758

* (1,2).

2

3

2-frame

3.

2. PIV

PIV

(Harvard Apparatus

, 1423 pulsatile pump)

Fig. 1

5mm

가

20×20 mm

60°

20×20mm

$r_1=2.35\text{ mm}$, $r_2=4\text{ mm}$

3

Fig. 1

3 mm

가

5W

Fiber optic

CCD (1K×1K, 640×480)

(2)

가 (conifer powder)

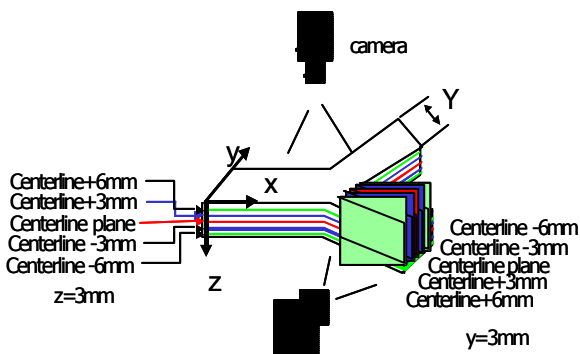


Fig. 1 Geometric configuration of the branching model

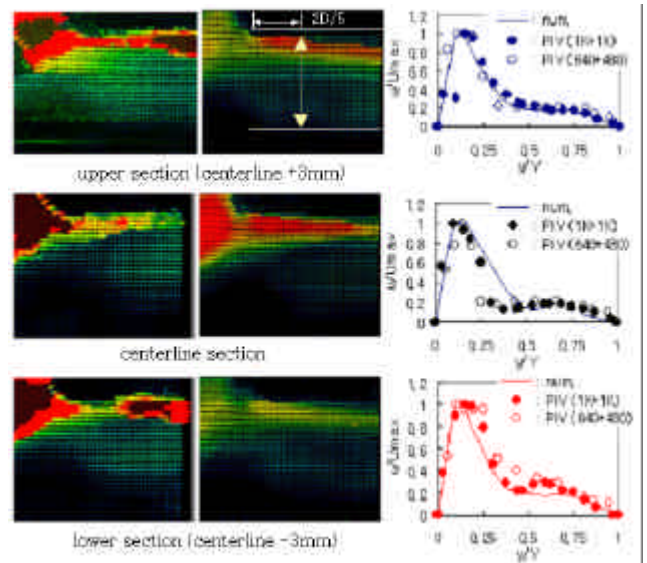
Re=400

Fig. 2

Fig. 3

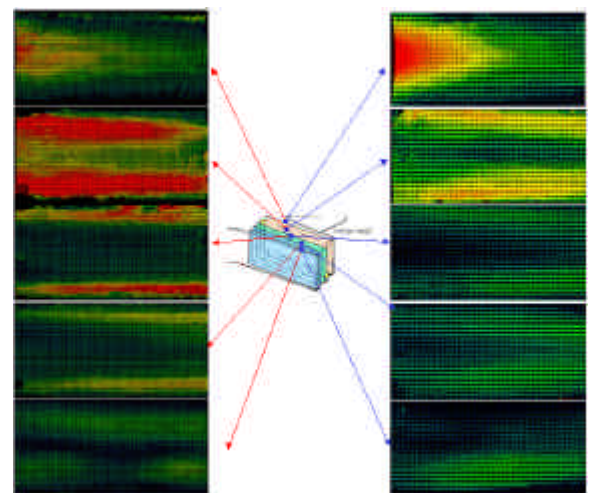
PIV

Fig. 2



(a) 640×480 camera (b) 1K×1K camera (c) velocity profiles

Fig. 2 Velocity vectors of the steady state at different horizontal sections



(a) 1K×1K camera

(b) 640×480 camera

Fig. 3 Velocity vectors of the steady state at different vertical sections

Fig. 2
1K×1K pixels
Fig. 2(b)
(a) (c)

640×480 pixels
가
3mm

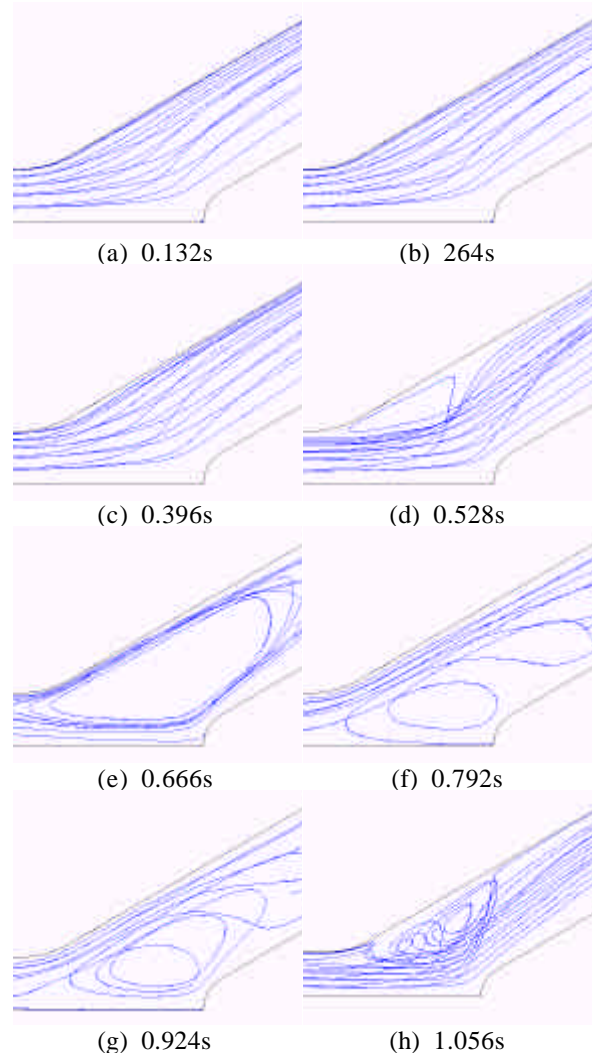


Fig. 4 Pictures showing particle path during the cycle of the pulsatile flow

Fig. 3
PIV
640×480
가
1K×1K

가
가

Fig. 2
PIV

, Fig. 3

Fig. 2

Fig. 4

4

Fig. 4 (a) (b) 가

(Fig. 4 (d), (e), (f))

Fig. 4

2

3

PIV
Fig. 4

가

stereoscopic PIV 3-D PIV

2D

1/30
1.1
Sine
Fig.

3
, PIV

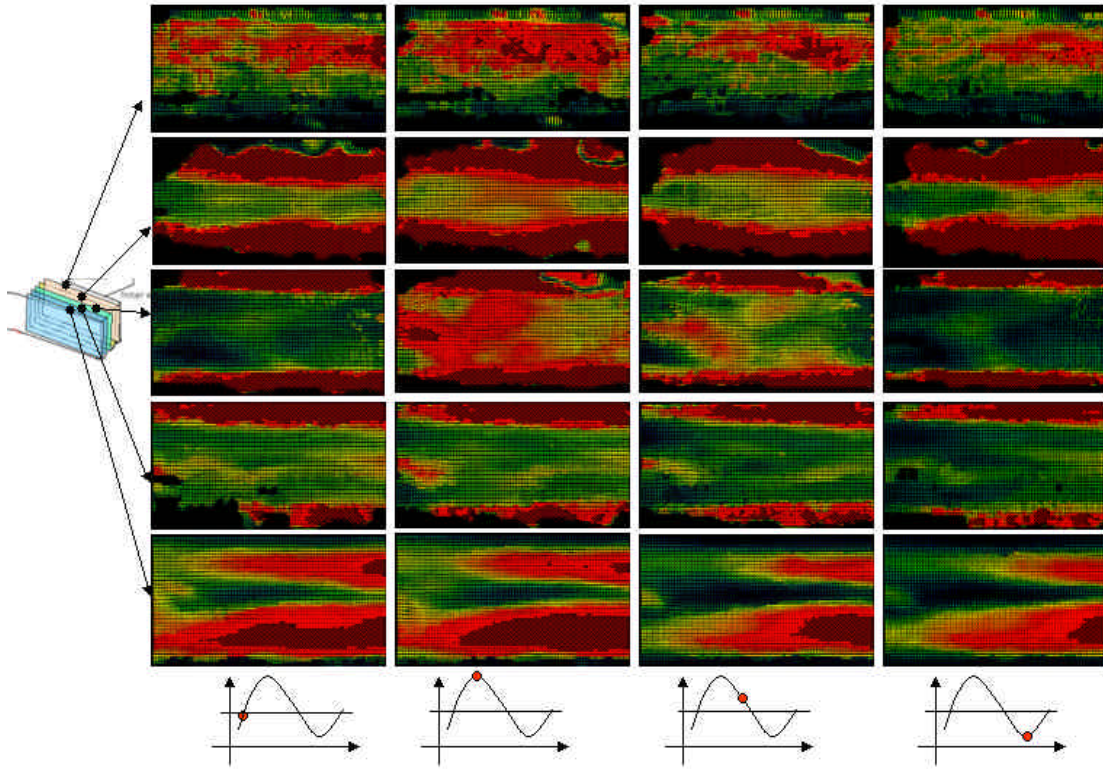


Fig. 5 Obtained velocity maps during the cycle of pulsatile flow using 1K*1K camera

PIV

가

3

Harvard

pump

가

stereoscopic PIV 3-DPIV

3

Fig. 5

Fig. 5

1

가

3mm 6mm

3mm 6mm

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(R01-

가

Fig.

5

가

가

(1) S. H. Suh, H. W. Roh, S. K. Sung, and D. W. Kim, 2003, "Three-Dimensional Flow Visualization for the Steady and Pulsatile Flows in a Branching Model using the High-Resolution PIV System", PIV03 Symposium, Paper No. 3317 (CD-Rom)

(2) , , , 1998, "

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