# Steady Flow in Various Geometries of the Carotid Artery Bifurcation

Ondrej Vesely, Ludmila Novakova, Josef Adamec, Tadeas Balek
Czech Technical University in Prague, Faculty of Mechanical Engineering. Technicka 4, 166 07 Prague. Czech Republic.
E-mail: O.Vesely@fs.cvut.cz, Ludmila.Novakova@fs.cvut.cz, Josef.Adamec@fs.cvut.cz, Tadeas.Balek@fs.cvut.cz

**The paper presents results of experimental investigation of steady flow in the region of common carotid artery (CCA). The CCA bifurcates into two branches: into internal carotid artery (ICA) and external carotid artery (ECA). ICA, that supplies blood to the brain is enlarged. This region is referred as the carotid sinus. In the present study, three models of the carotid artery bifurcation have been manufactured. The models vary in geometry of the carotid sinus. Their effect on fluid flow has been investigated under steady flow condition, utilizing Particle Image Velocimetry (PIV) and flow visualization. The flow conditions approximate physiological flow. The measuring range of Reynolds number was from 400 to 1300. Experimental results indicated the effect of carotid sinus geometry on the main flow in common carotid artery.**

**Keywords:** Carotid Artery Bifurcation, PIV, Visualization

## References

[1] NAGAI, Y., KITAGAWA, K., SAKAGUCHI, M. et al. (2001). Significance of earlier carotid atherosclerosis for stroke subtypes. *Stroke*. Vol. 32. 1780 – 1785.

[2] ROGER, V. L., GO, A. S., LLOYD-JONES, D. M., et al. (2012). Executive summary: heart disease and strokes statistics – 2012 update: a report from the American Heart Association. *Circulation 2012*. Vol. 125. 188 – 197.

[3] DAVIES, P. F., TRIPATHI, S. C. (1993). Mechanical stress mechanisms and the cell. *Cric Res*. Vol. 72. 239 – 245.

[4] GIDDENS, D. P., ZARINS, C. K., GLAGOV, S. (1993). The role of fluid mechanics in the localization and detection of atherosclerosis. *J. Biomech*. Vol. 115. 588 – 594.

[5] HEUSSER, K., TANK, J., ENGELI, S., et al. (2010). Carotid baroreceptor stimulation, sympathetic activity, baroreflex function, and blood pressure in hypertensive patients. *Hypertensions*. Vol. 55. 619 – 626.

[6] BEEKMAN, H. R., KATZ, P. B., MOOREHEAD-STEFFENS, C., et al. (1983). Altered baroreceptor function in children with systolic hypertension after coarctation repair. *The American Journal of Cardiology*. 1983. Vol. 52. 112 – 117

[7] SEDLÁK, J., CHLADIL, J., SLANÝ, M., et al. (2014). Introduction to processing of CT clinical metadata of disabled part of patient knee joint. *Manufacturing technology*. Vol. 14. 611 – 618.

[8] LEE, S. W., ANTIGA, L., SPENCE, J. D., et al. (2008). Geometry of the carotid bifurcation predicts its exposure to disturbed flow. *Stroke*. Vol. 39. 2341 – 2347.

[9] WELLS, D. R., ARCHIE, J. P., KLEINSTREUER, C. (1996). Effect of carotid artery geometry on magnitude and distribution of wall shear stress gradients. *J Vasc Surg.* Vol. 23. 667 – 678.

[10] ZURONG, D., KEQIAN, W., JIE, L., et al. (2001). Flow field and oscillatory shear stress in a tuning-fork-shaped model of the average human carotid bifurcation. *Journal of Biomechanics.* 1555 – 1562.

[11] NOVOTNÝ, J. (2012). *Influence of data quality on PIV measurement accuracy.* Journal of Flow Visualization and Image Processing. Vol. 19. 215 – 230

**Paper number: M2015176**