# Analysis of Blood Flow Parameters to Detect Abnormalities in Blood Vessels

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***Abstract-*** *The cardio vascular system of the human body consists of a large number of blood segments with various properties, and thus, the pulsating blood flow of the human body is extremely complicated. The blood flow along with the blood pressure is of equal importance. It describes the supply of blood in various parts of the body. Recently, various techniques have been developed for analysis of blood flow. These analyses detect abnormalizes in blood vessels such as: aneurysms, clots etc. This proposed paper provides a literature survey approach of various methods to automatically detect abnormalities in blood vessels.*

***Keywords***- Blood flow, Aneurysms, hemodynamic characteristics

## I. INTRODUCTION

The mortality rate in developed countries is very high due to cardiovascular diseases. The major parts of our body such as, (1) the brain-suffers from stroke and (2) the heart-suffers from myocardial infraction. These conditions may cause instant death. For this reason, the study of blood flow is of utmost importance.

The blood flow in a human body is mostly laminar which has a constant velocity and is easy to analyze. Also, the flow pattern will be smooth and not disrupted. Turbulent blood flow occurs when there is an abnormality in blood vessel, which is very complex. These abnormalities could be a clot or an aneurysm which disrupts the blood flow, which does not allow the blood to reach its destination. Therefore, an early detection and monitoring of abnormalities. In recent times a number of techniques have been proposed to analyze blood flow.

This paper provides a literature review of the various ways to detect abnormalities in blood vessels. Early detection of abnormalities will prevent fatal events.

## II. LITERATURE SURVEY

When the walls of arteries weaken, the velocity and pressure of the blood flow changes. A weakened artery if not diagnosed on time may give rise to aneurysm and in course of time might rupture, thus causing an even bigger problem such as stroke and myocardial infraction. Numerous computer simulation schemes have been developed over the years to detect and diagnose weakened blood vessels, aneurysms and other abnormalities in blood vessels. This section of the paper mainly focuses on the different approaches developed over the years by the authors in literature for accurate ways to detect abnormalities on blood vessels.

Steffen Oeltze-Jafra, Juan R. Cebral, G´abor Janiga, and Bernhard Preim in [1] proposed that computer fluid dynamics (CFD) simulations help in understanding the dynamic characteristics of blood flow to extract crucial information for proper diagnoses. The studies say that there are vortices present in the blood flow patterns. These vortices lead to aneurysm rupture. Here, a clustering approach is presented for analysis of vortical flow. Streamlines of the blood are grouped together to find embedded vortices. These grouped streamlines show a detailed visualization of the flow pattern. These visualizations were also viewed by a group of experts to get better advice and results. It was concluded that hemodynamic characteristics are important to detect abnormalities in blood vessels. The more dynamic characteristics analysed the better is the detection process.

Rocco Gasteiger, Dirk J. Lehmann, Roy van Pelt, G´abor Janiga, Oliver Beuing, Anna Vilanova, Holger Theisel, and Bernhard Preim in [2], also use hemodynamic characteristics such as inflow jet and impingement zone that are related to the risk of aneurysm rupture. These parameters are investigated visually by CDF. Here, streamline properties of the blood flow are used to find out the inflow jet and impingement zone. A boundary contour is used to extract the inflow jet on the ostium (neck of an aneurysm) which is then used to identify the impingement zone. This is an automatic and robust method to detect abnormalities in blood vessels.

H. Zakaria, A. Kurniawan, T.L.R. Mengko, and O.S. Santoso in [3] described an approach to detect celebral aneurysm by using 2D digital subtraction angiogram (DSA) imaging and calculation of time to peak and time duration of flow of contrast agent that travels in the blood vessels. DSA imaging is an advanced and improved method over traditional

techniques to visualise blood vessels and subtract the other structures of the human body. The time duration for the contrast agent to travel in a blood vessel will be different for a normal blood vessel and an abnormal blood vessel. This is a simple, yet effective method of detecting an abnormality in a blood vessel. Large aneurysms (greater than 7mm) can be detected using this method.

Amanda Randles, Erik W. Draeger, Tomas Oppelstrup, Liam Krauss and John A. Gunnels in [4] describes, that the entire arterial structure provides insights about abnormalities in blood vessels and also enables the study on global hemodynamic. A robust method of the lattice Boltzmann method which uses limited memory and also saves bandwidth in complex geometries. A strong scaling of three-dimensional, high resolution simulation of hemodynamic was demonstrated.

Hyo Won Choi, Tong Luo, Jose A. Navia and Ghassan S. Kassab in [5] demonstrated a method to detect an abnormality based on the geometric arch of the aorta. The blood flow pattern of the aorta is very complex and multidirectional in a human body which can affect the geometry of the aorta. The change of geometry will give rise to clot motion and in turn give rise to fatal events. Patient-specific aortic models have been examined. The curvature of these specific models has been examined. The present findings have provided with a working hypothesis for future studies. The risk of curvature is an important factor which might cause a stroke.

## III. CONCLUSION

Not only the blood pressure, but also, the blood flow gives important information. It describes the supply of blood that reaches the organs and tissues. Abnormal changes in the blood flow changes the velocity and pressure of the blood flow. These abnormalities could be due to various reasons because of which it needs to be diagnosed on time to receive proper treatment and fatal events can be avoided.

This proposed paper provides a detailed survey of various techniques and algorithms proposed in literature. Therefore, the algorithm developed for blood flow analysis must provide high degree of accuracy and fast execution time.

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