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INSIDE THIS ISSUE

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Thesis Title: Automatic Detection of Retinal Features for Screening of Diabetic Retinopathy using Image Processing Techniques.

PhD Guide: Dr. Gopalakrishna Prabhu K
Professor in Department of Biomedical Engineering & Registrar, Manipal University
Date of PhD Award: 24th September 2011
University: Manipal University, Manipal, India

Diabetes mellitus, a metabolic disorder, has become one of the rapidly increasing health threats both in India and worldwide. The complication of the diabetes associated to retina of the eye is diabetic retinopathy. A patient with the disease has to undergo periodic screening of eye.

EDITORIAL

SADANAND B KULKARNI

Welcome to May issue of ENGMEDNEWS. It gives me distinct pleasure to enlighten all of you about the research work done on two articles that is published in this newsletter.

The first article mainly focuses on the development of an automatic system, for the purpose of detecting anatomical and pathological features in colour retinal images, with its application to diagnosis of diabetic related eye diseases.

The second article describes about the use of biological and mechanical prosthetic heart valves. It gives the pros and cons of both the valves and the necessary experiments taken to overcome the disadvantages.

I believe that these research works have uplifted the technology of medical world by making it cost effective and faster.

I hope you all find this newsletter informative and useful.

For the diagnosis, ophthalmologists use colour retinal images of a patient acquired from digital fundus camera. Limited number of specialist ophthalmologists in most of the countries motivates the need for computer based analysis of retinal images using image processing techniques. This could reduce the workload of ophthalmologists, also aid in diagnosis, to make measurements and to look for a change in lesions or severity of disease. The work in this thesis mainly focuses on the development of an automatic system, for the purpose of detecting anatomical and pathological features in colour retinal images, with its application to diagnosis of diabetic related eye diseases.

Prolonged diabetes causes micro-vascular leakage and micro-vascular blockage within the retinal blood vessels. Therefore segmentation of retinal vasculature is of primary interest in the detection of retinopathy. Filter based approach with a bank of Gabor filtersare used to segment the vessels. The result of vessel segmentation could help in registering two images in order to compare images taken at different examinations for monitoring the progression of the disease.

The accurate segmentation of optic disc is often an essential prerequisite step in identification of other retinal anatomical and pathological features. Iterative thresholding method followed by connected component analysis is employed to locate the optic disc and to find its approximate center. Geometric model based implicit active contour is applied to find the exact boundary of the optic disc. The result of optic disc localization could be used to localize macula or fovea, the other retinal anatomical feature. Also, the optic disc is masked during the detection of lesion, that is, hard exudates to avoid false positives. The result of boundary detection could be used to detect early signs of Glaucoma, which is another sight threatening disease in the eye in which the optic nerve is damaged in a characteristic pattern. This can permanently damage vision in the affected eye and lead to blindness if left untreated

Maculopathy is one of the sight threatening stages of diabetic retinopathy. The macula is the central area of your retina. It is responsible for all your sharp vision, such as used for watching TV or reading. It can become damaged in diabetes, usually with leaks developing. Onset of exudates in the macular region is indicator of macular edema. Manually, severity of maculopathy is decided based on the distance of exudates from the center of macula. As the manual method is highly subjective, an automatic maculopathy detection and severity level grading into mild, moderate and severe is presented. It is hoped that this system could assist the ophthalmologists to detect the signs of diabetic maculopathy and its severity level in lesser time. The sample image data used to validate the system was comparable with the manual graders with regard to severity of the disease. A user interface is also provided for speedy analysis of large number of retinal images during mass screening. It is hoped that the system could assist the ophthalmologists, to detect the signs of diabetic retinopathy in the early stage, Diabetic retinopathy, the most common diabetic eye disease, occurs when blood vessels in the retina change. Sometimes these vessels swell and leak fluid or even close off completely. In other cases, abnormal new blood vessels grow on the surface of the retina. This system is used for better treatment plan and to improve the vision related quality of life.

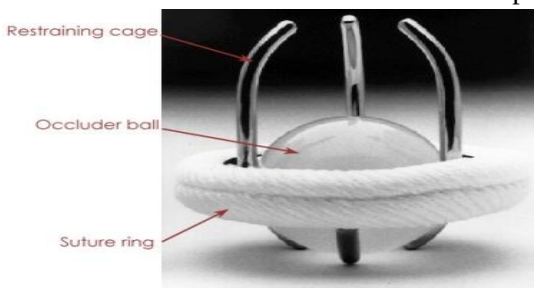
Study of the Velocity and Strain Fields in the Flow Through Prosthetic Heart Valves

By

Praveen .S. Hitnalli

INTRODUCTION

A comparative experimental study of the velocity field and the strain field produced down-stream of biological and mechanical artificial valves is presented. In order to determine the spatial and temporal distributions of these fields, a phase-locked stereoscopic particle image velocimetry (or 3D-PIV) technique was implemented. Emphasis was placed on the identification of the fundamental differences between the extensional and the shear components of the strain tensor. Heart valves that fail to perform their physiological function correctly can be replaced either by mechanical or biological prosthetic valves. In terms of hemodynamic performance, biological valves are generally considered to be superior to their mechanical counterparts because their thrombogenic potentials are similar to the ones observed in native human valves. Nevertheless, owing to calcification processes, tissue overgrowth and leaflet wear, their durability is limited to about 15 years. Mechanical valves, on the other hand, last much longer but possess design-related problems such as highly irregular flows, regurgitation, leakages, and stagnated fluid regions, which cause severe blood cell damage and thrombosis. The elevated shear and turbulent stresses commonly produced in the transvalvular and downstream flow regions could induce membrane disintegration (lysis), multiple cell-to-cell collisions, coagulation, unfolding and activation of platelets and blood factors, as well as aggregate formations .In addition, the exposure time to these conditions has been identified as a critical factor in the damaging and activation pro



Biological heart valves

Several current experimental investigations are aimed at producing detailed descriptions of the flow field across valves by recursing to advanced measuring methods such as the Laser Doppler Anemometry, or optically based methods that allow observations with enhanced resolutions. The transvalvular flow region is of a fundamental character. The von Willebrand factor (one of the key elements involved in the coagulation process) becomes activated beyond a certain level of the velocity gradient in a simple shear flow. It must be noted that the stress levels corresponding to these shears are much lower than those reported for the activation of platelets or for damaging red blood cells. In the case of a complex flow field, the velocities may change substantially in all components.

Therefore, understanding the relative importance of the components of the strairn becomes crucial. This paper provides comparative view of the flow structures produced by biological and mechanical artificial valves and, thereby, complement previous findings. The focus of the investigation was placed on the phase-averaged strain distributions and their magnitudes downstream of the valves. The primary objective was to establish the relative importance of the extensional and shear components of the strain tensor. A phase-locked stereoscopic particle image velocimetry (3D-PIV) technique was implemented to determine the rapid variation of the velocity fields and to identify the stagnation and agitated flow regions.

II. Particle Image Velocimetry (PIV) Technique:

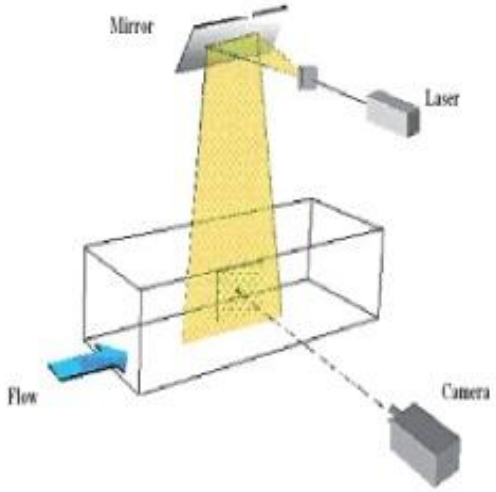
Particle Image Velocimetry is an optical method of flow visualization used in education and research. It is used to obtain instantaneous velocity measurements and related properties in fluids. The fluid is seeded with tracer particles which, for sufficiently small particles are assumed to faithfully follow the flow dynamics. The fluid is entrained particles is illuminated so that particles are visible. The motion of seeing particles is used to calculate speed and direction (the velocity field) of the flow being studied.

Typical PIV apparatus consists of –

- Camera
- Strobe or laser
- Synchronizer
- A fiber optical cable or liquid light guide

The main difference between PIV and other techniques (Laser Doppler Anemometry) is that PIV produces 2D or even 3D vector fields while the other techniques measure the velocity at a point. During PIV, the particle concentration is such that it is possible to identify individual particles in an image.

One of the main objectives of the study was to determine the relative magnitude of the components of tensor used to obtain instantaneous velocity measurements and related properties in fluids. The fluid is seeded with tracer particles which, for sufficiently small particles are assumed to faithfully follow the flow dynamics. The fluid is entrained particles is illuminated so that particles are visible. The motion of seeing particles is used to calculate speed and direction (the velocity field) of the flow being studied.



the shear tensor throughout the cycle. The importance of this analysis stems from the fact that most investigations concerning blood damage involve only pure shearing conditions. Nonetheless, other studies indicate that the extensional effects are also relevant in the membrane deformation process of the capsules and droplets. The analysis of the strain components allows a more general description of the blood damaging potential of each prosthesis. In particular, a connection is attempted with the cumulative trauma history of the blood constituents. The frequency with which the strain variations occur at particular instants and locations could be associated to the cumulative damage process of the blood constituents and should be taken into account in the overall assessment of existing valve types, as well as in future design efforts.

BMESI, Manipal Chapter:

The BMESI, Manipal chapter is an active student community which aims to bring people closer to the heart of Biomedical Engineering. Being the headquarters of BMESI India, it comprises of students pursuing Biomedical Engineering in Manipal Institute of Technology, Manipal. Amongst the various events organised round the year, a few of them in a nutshell:

BMESI, Manipal had started the year with an overwhelming involvement in the college's technical festival. We conducted two events: Biotronics – a three round event which tested the astuteness and the practical aspect of Biomedical Engineering, and Rehabology- an event which focussed on rehabilitation. Both the events had received a great response from students of all faculties. It was followed by a workshop on MATLAB.

The next semester was initiated with 'First Meet'- an event where acumen met amateurs. A lucid talk by our HOD Dr. Ramesh Galigekere, the seniors' report of their internships and an open interactive session successfully addressed the qualms of the incoming Biomedical Engineers. This was followed with a seminar on Genetics, by Dr. M. R. Sekhar from Manipal Institute of Life Sciences (MLSC), Manipal. A competition on applications based on the 555 timer was also conducted. The competition brought out elegant innovations like a cyclone detector and a railway crossing system, using simple 555 circuits.

As we approached the end of the year, a fun-filled badminton and football tournament was held for the students of our branch. The academic year ended in grandeur with a cultural programme, TADAA! A variety of games such as Scrabble and Anti-chess were hosted and prizes were handed out. For the upcoming year, BMESI Manipal is coming up with a couple of new workshops and seminars. That concluded an eventful tenure, and the team signed off hoping for a bigger and better year up front.

FORTHCOMING EVENTS

3rd MRI training course (for technicians, technologists, biomedical engineers, radiologists)

TECHNICIANS:

Fresh technicians can learn the basics of MRI and their application. Technicians who are already working on MRI machines can enhance their skills and know more about improving the quality of MRI.

BIOMEDICAL ENGINEERS:

You can understand the basics of functioning of the MRI machine and also learn about basic maintenance issues.

MRI RESEARCHERS:

You can gain a complete understanding of the physics, engineering, instrumentation, applied and clinical aspects of the MRI.

RADIOLOGISTS:

This course offers you a never before opportunity to really understand everything you wanted to know about MRI. It is advisable that you attend the course with your technicians so that you can make the most out of this course.

RADIOLOGY RESIDENTS:

It will help you in preparing for imaging physics questions of postgraduate examinations.

Venue: Auditorium, Nanavati Hospital

Mumbai

Date: June 9-10,2012

International Conference On Laser Advances in Science Engineering and Research(ICLASER 2012)

ICLASER 2012 conference organized by Dept. of Medical Electronics is dedicated to Golden Jubilee Celebrations of M.S.Ramaiah Institute of Technology(MSRIT),Bangalore, India.

The main focus areas of ICLASER 2012 include

- Laser Fundamentals, Engineering & Safety
- Diagnostic Lasers
- Non-Surgical Lasers
- Surgical Lasers
- Low level Laser Therapy
- Laser Technology-Innovation, Advances and Applications.

Who can attend ICLASER 2012

Anyone interested in attending one-day certification course for basic understanding of the laser tissue interaction concepts to aesthetic/dermatology procedures and get hands-on orientation to laser use

Pre-Conference workshop

One day pre-conference certification course is developed to provide practical laser training in Aesthetic/ Dermatology Procedures" that includes lectures, demonstrations and hands on orientation to laser use. Additionally, course material including "Lasers in Medicine & Surgery" textbook and slide notes will be provided in the registration kit.

Venue

Pre-conference workshop: 7 June 2012

Conference: 8 – 10 June 2012

Exhibition: 8-10 June 2012

Apex Block Auditorium

Level 8 & 9 , MSRIT

Conference

Day 1:Friday 8 June 2012

Day 2: Saturday 9 June 2012

Day 3:Sunday 10 June 2012

Call For Papers

Authors are requested to submit their abstracts on or before 20 Jan 2012. Abstracts are only accepted online. Selected abstracts ,after peer review will be published in the Book Of Abstracts which will be included in the registration kit.

For more detail please visit the below link:-

http://iclaser.msrit.edu

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