OSMIA MEETING MINUTES

Subject:	OSMIA Open Source Introduction Meeting
Purpose/Objectives:	First contact meeting
Date & Venue:	04.04.02 & 05.04.02 ISBE, Manchester University
Reference:	OSMIA-M1
Attendees:	NAT, AJL, SMcK, PW, JB, SR
Distribution:	ALL + Voxar

1 Introduction

Introduction project meeting and tutorial for TINA environment. The meeting had several aims. i) to provide an initial source of contact for the members of the project involved in the open source research aspects of the project. ii) to better understand the desires of the groups at DCU and UoWO and ensure the project is structured in a way which doesn't prevent such work. iii) to familiarise the open source partners with the origins of the software system TINA. Voxar did not attend this meeting as the focus was on the open source projects.

2 Apologies for Absence

None

3 Project Overview

Neil Thacker outlined the aims of the project reviewing the roles of each of the partners.

4 Clinical Aspects of Cardiac MR

Simon Ray (a clinical cardiologist from South Manchester University Hospitals) described the problems of cardiac imaging. PW and JB are intending to collaborate on an MR cardiac imaging project as a test of the TINA environment.

The practical problems of cardiac imaging have often resulting in ultrasound techniques being used as a primary source of measurement. SR outlined the many practical advantages of MR. SR described what he considers to be the key questions;

- Chamber size
- Wall thickness (derived LV mass)
- Pumping capacity (ejection fraction)
- Ideally without prolonged breath hold
- Automated border detection for calculations

- transvalvular flow;
  - Gradient across narrowed valves
  - Ideally valve area
  - Volumetric flow through leaking valves
- Anatomical anomalies
- Myocardial perfusion
- Myocardial viability
- Intra-myocardial mechanics
- Coronary artery imaging

It was agreed that fundamental to all of these problems was the issue of heart motion and how the heart could be tracked in a sequence of images.

For image data SR suggested both the Leeds and Bromptom groups (Don Fermin).

SR expressed an interest in being involved in the TINA/OSMIA user groups.

Action: AJL

5 Technical Perspective I

John Barron described his research interest in cardiac MR. JB described the optical flow techniques he will introduce into TINA. JB described ideas for combining the Lucas and Kanade and the Horn and Schunch approaches. Simoncelli (ICIP 94) described a technique for smoothing velocity estimates which could also be useful. JB will integrate these techniques into TINA providing demonstration datasets.

Another approach JB also intends to try using segmentation techniques to build surface models of the heart or components of the heart building a polygonal surface mesh. JB intends to investigate the use of VTK to assist in this. JB also intends to investigate the use of NURB surfaces to build control base surfaces from this data. JB then discussed how the surface model might be used to gain motion segmentation.

(JB slides attached to minutes as Appendix A)

6 Technical Perspective II

Paul Whelan introduced the work done at DCU. In particular automated Polyp detection in the Colon. PW described how DCU have investigated issue of HCI regarding the segmentation of the colon so that the structural information is provided to the clinician in a form which is diagnostically of most use. Most interesting Polyps about 5mm. PW also described work being done on visualising the Biliary tree.

There was a length discussion of how NeatVision and TINA could be integrated. It was agreed that NeatVision should not become simply another front-end for TINA. NeatVision should benefit from integration with TINA in a way which supported the NeatVision philosophy. It was suggested that NAT suggested that NeatVision could also make use of many of the robotic vision algorithms in TINA.

PW ended by outlining the current status of the work at DCU. Hardware was currently being purchased and personnel were already working on it.

7 TINA: Current Status

AJL discussed current TINA status. He outlined the background and motivation to TINA and why these ideas are just as valid today, particularly in the context of wider community research. AJL described how work on the project would enhance these characteristics in TINA. AJL described the basic development plan for the open source (wp2) side of the project.

8 Proposal

AJL reviewed the proposal ensuring that all parties had understanding of what was required. AJL described the potential changes to TINA and how they might affect the other project members.

Questions for the commissioner;

JB wants to know if he will need to keep time sheet data.

Action: AJL

PW wants to know how man hours a man day is.

Action: AJL

9 Workpackages

A review of workpackages 2 & 4 lead to the following actions;

Produce individual webpages for each of the two projects. These will be linked from the main site and should link back to the main site also.

Action: JB, PW

Get further cardiac MR data from Guys (Derek Hill).

Action: NAT

Introduce PW and JB to mailing list once new server is up and running.

Action: AJL

3D scan of a heart model as phantom data.

Action: JB

10 Any Other Business

It was decided that representatives of Voxar would be invited to the next meeting.

Action: AJL

Date and Place of Next Meeting

Dublin, September (TBC)

Action: PW

Appendix A : John Barron notes

OSMIA-UWO-1

We will compute 3D optical flow on gated MRI cardiac data using Lucas and Kanade [IJCAI 1981]:

$$I_x u + I_y v + I_z w = -I_t,$$

where (u, v, w) is the 3D velocity and (I_x, I_y, I_z, I_t) are 1^{st} spatio-temporal derivatives. A second approach is to use Horn and Schunck's approach [AI1981], i.e. a global minimisation by

$$\int Ixu + I_y v + I_z w + I_t + \alpha^2 \left(u_{xx}^2 + u_{yy}^2 + u_z^2 + v_{xx}^2 + v_{yy}^2 + v_z^2 + w_{xx}^2 + w_{yy}^2 + w_z^2 \right) `.$$

where α^2 is the Lagrange multiplier. We'll use Simoncelli's balanced filters [ICIP94] for smoothing and differentiation.' Currently we have one MRI data set ($256 \times 256 \times 31 \times 20$). We need higher resolution data and more of it!!!

OSMIA-UWO-2

Our intermediate plans: Integrate the 2 optical flow algorithms (in 2D and 3D) into TINA by the end of this summer. We would like to be able to display the 2D/3D optical flow vectors in TINA. Will optical flow work on MRI data: don't know but I expect NO!!¡

John Moore will be a new MSc graduate student starting in September 2002. He has taken various computer graphics courses and is mildly similar with VTK.

OSMIA-UWO-3

Our 2^{nd} approach: segment the Heart surfaces from the surrounding data using the Marching Cubes algorithm $\Rightarrow$ MRI data has been reduced to a polygonal mesh (planar triangles). The advantages of this approach is that the data has been reduced in size and is now easy to animate. The disadvantage if that binary decisions have been made about whether voxels are surface points on nor, if the decision is wrong how can be recover?

VTK does the type of surface segmentation using the Marching Cubes algorithm and lets one "deciminate" the data to reduces the number of polygons. Decimination rates of up to 95% are feasible.

OSMIA-UWO-4

I propose to avoid the decimination step by determining the key features of the surface (How?) Determination of key feature points will be difficult and might be done taking temporal properties (temporal persistence for example) into account? Segmentation of surface data will be a challenging task.

These key feature points become control points for a closed surface spline parameterisation. We plan on using NURBS (Non-Uniform Rational B Splines). Some advantages: given the appropriate knot vector/matrix we can make a NURBS be any kind of spline. Also perspective projection is more natural.

OSMIA-UWO-5

How to do motion estimation? We can integrate (using least squares) local normal velocities to get full velocities.

- the normal direction is simply the normal at the surface point (this is easily computed from parameterised spline surfaces).
- At one time, choose a surface point. Trace it until a surface point in the next image is intersected. The length of the vector would be used to approximate the normal magnitude.
- Given local normal velocities, we can integrate them into full velocities using least squares.