

NEWSLETTER – FEBRUARY 2009

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1. A NEW EXTENSION OF BIOMOUTH – JAW EXOSKELETON (BY PETER XU)

Recently Peter and Andrew got a research grant from FRST under the category of IIOF (International Investment Opportunities Fund). The funding of 1.2m for 3 years is for novel enabling technologies for wearable assistive devices. There are four research tasks, one of which is develop a Jaw Exoskeleton device for rehabilitation of jaw motion disorder. With this funding, 4 PhD students will be recruited from the background of mechatronics, bioengineering, actuator & control, and artificial intelligence. According to the IIOF requirement, the same project will be encouraged to merge into ordinary FRST funding scheme.

2. NEW PHD PROJECT TO START IN MAY (BY KYLIE FOSTER)

Jeanne Cheong will start the PhD project Massey University has as part of a new Foundation for Research, Science and Technology (FRST) programme studying the relationships between food structure and sensory perception (as detailed by Marco Morgenstern in the September 2008 newsletter). Jeanne will focus on following the breakdown of model food structures in the mouth and, in particular, investigating how masticatory behaviour adapts to changing food bolus properties throughout a masticatory sequence. Jeanne is also likely to make use of the robotic jaws developed at Massey University to assess the forces applied during the mastication of these model food structures. Jeanne has an MSc in Food Technology (Food Nanotechnology) from Universiti Putra Malaysia and is currently working in an academic position at this university. She will be supervised by Kylie Foster, John Bronlund, John Grigor (all from Massey University), Bryony James (Auckland University) and Marco Morgenstern (Plant and Food Research). This project will link in closely with another PhD project funded by this programme and based at Auckland University.

3. NEWS FROM OTAGO UNIVERSITY (BY JULES KIESER)

The most important news from down South is that Dan Kennedy has submitted his thesis on dynamic changes in intra-oral pressures during swallowing and was rewarded for his efforts by a newly minted Doctorate. Dan is now locuming as an orthodontist prior to joining an esteemed Craniofacial Abnormality Unit in the States. These results are currently being

written up for Dysphagia and will be presented at the Annual Dysphagia Conference in New Orleans next month. Were delighted that Dan's work is being continued by Nitin Raniga, another of Jules' Orthodontic students.

We are absolutely overjoyed that we have acquired a new Chair of Orthodontics, Prof Mauro Farella DDS PhD, who completed his training in electromyography at the University of Naples. His main focus of research is electromyography of the muscles of mastication and their role in the generation of orofacial pain. The next issue will contain his full biography.

The work on **Sphenodon**, the Kiwi icon tuatara continues unabated, with some great new data on sutural structure and also its dentition. This was presented at the recent 14th International Symposium on Dental Morphology 27-30 August Greifswald, Germany. Together with **Dr Warwick Duncan**, summer students **Joy Tahere and Hannah Green** have gathered even more data, all awaiting analysis. An example of one of Joy's reconstructions is figured below.



Finally, Jules is organizing our annual **BIOMOUTH SYMPOSIUM** – the date is 11th June 2009 and the location is the Hunter Centre, University of Otago. Our esteemed guest lecturer will be **Prof Peter Lucas**, whose book **Dental Functional Morphology** is already a classic that will be doubt familiar to all of you.

4. UPDATE FROM YIKUN WANG (BY YIKUN WANG)

Currently, I am struggling with correcting my masters thesis but this should be finished in the next few days. I will stay at the Auckland Bioengineering Institute for my PhD study. My PhD research will focus on improving the quality of the tongue model and the experimental validation.

Abstract from masters thesis:

Modelling of Interlacing Muscle Fibres Within the Tongue

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The tongue is a dextrous organ. Because of its complicated structure and shape, and its limited visibility, its biomechanical behaviour is relatively poorly understood. One of the challenges of modelling the biomechanical behaviour of the tongue is its complex material description, in particular the fact that the tongue is made up of several different muscle groups of which three exhibit interlacing muscle fibres in much of the same way as woven textiles. The purpose of this work is to develop a 3D finite element model of the tongue that includes an anatomically realistic description of the muscle fibre distribution and hence is capable of providing us with a better understanding of the complex deformation patterns of the tongue during normal mastication, swallowing, or speech production.

Within this project, an anatomically-based, three-dimensional, computational model of the human tongue is described. The computational model is an extension of the one published in [1], which provides anatomically accurate information of tongue's muscle fibre distribution. The large deformations of the tongue stemming from its complex movements are described using the governing equation of finite elasticity, which are described using the finite element method and cubic Hermite basis functions. The material properties of the tongue are modelled using a multi-fibre-reinforced hyper elastic material description that exhibits passive and active contractile properties along its fibre directions. For this purpose, the second Piola-Kirchhoff stress tensor is constructed by enhancing an isotropic part, which resembles the ground matrix of the tongue, by the sum of each additional fibre stress stemming from the respective passive and active component of the particular muscle groups. The model is implemented and tested using CMISS, a finite element software package developed at the University of Auckland.

The activation of specific muscle fibre groups demonstrated simple but realistic deformations of the tongue. The influence and biomechanical behaviour of the interlaced muscle fibres within the tongue are studied. Future extensions to this work are the customisation of the presented generic tongue model to subject-specific models stemming from MRI data.

References:

[1] Wu, M.-C., Han, J.C., Röhrle, O., Thorpe, W., Nielsen, P., "Using Three-Dimensional Finite Element Models and Principles of Active Muscle Contraction to Analyse the Movement of the Tongue", Proceedings 11th Australasian International Conference on Speech Science and Technology, 2006, ed. P. Warren & C.I. Watson, pp. 354-359.

5. 3RD ANNUAL BIOMOUTH SYMPOSIUM

3rd ANNUAL BIOMOUTH SYMPOSIUM

10 - 11th June 2009

**Sir John Walsh Research Institute
Faculty of Dentistry, University of Otago**



REGISTRATION 10 June 2.00PM

VENUE

Room 123 Hunter Centre (opposite the Dental School)

PROGRAMME

Wednesday 10th Registration & Planning session
Thursday 11th Presentations

CONFERENCE DINNER

Wednesday 10th

CONTACT DETAILS

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DEADLINE FOR ABSTRACTS

22nd May

email to jules.kieser@otago.ac.nz

**Guest Lecturer Peter W Lucas
Department of Anthropology
George Washington University**

6. INTERNATIONAL CONFERENCE ON BIODENTAL ENGINEERING (BY OLIVER ROEHRLE)

We are very pleased to announce you that The International Conference on BIODENTAL Engineering will be held in the Sheraton Porto Hotel & SPA, Porto, Portugal, on June 26-27, 2009.

Due to your research activities in related fields, we would like to invite you to submit a contributed paper. Your contribution is mostly welcomed and we would be honoured if you could participate in BIODENTAL.

Conference Topics (not limited to):

- Biomechanical disorders;
- Orthodontics;
- Implantology;
- Aesthetics;
- Dental;
- Medical device;
- Medical image.

Invited Lecturers (not yet closed):

- "Towards facial simulation"

B. Walker (Arup), L. Beldie (Arup), Y. Lu (Cardiff University), S. Richmonds (Cardiff University), J. Middleton (Cardiff University)

- "Facial soft tissue modeling"

L. Beldie (Arup), Y. Lu (Cardiff University), H. X. Zhu (Cardiff University), B. Walker (Arup), S. Richmonds (Cardiff University)

- "Human temporomandibular joint simulation"

A. Perez del Palomar (University of Zaragoza), M. Doblare (University of Zaragoza)

Publications:

The proceedings book will be published by the Taylor & Francis Group.

The organizers will encourage the submission of extended versions of the accepted papers to related International Journals.

Important dates:

Deadline for abstract submission: 27th March, 2009; Final Papers: 29th May, 2009.

We are looking forward to host you in Porto next June.

Yours sincerely,

Sónia Santos

Renato Natal Jorge

João Manuel R. S. Tavares

Mário Vaz

Reis Campos

(Organizing Committee - University of Porto, Portugal)

For more details regarding BIODENTAL, please visit the conference webpage at:

<http://www.fe.up.pt/biodental>