

# NEWSLETTER – OCTOBER 2006

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## 1. PREVIOUS BIOMOUTH NEWSLETTERS

Previous newsletters can be found under:

<http://www.bioeng.auckland.ac.nz/people/rohrle/Frames/Biomouth/BiomouthMain.htm>

## 2. THE BIOENGINEERING INSTITUTE, UNIVERSITY OF AUCKLAND (BY OLIVER RÖHRLE)

The paper entitled “Three-dimensional finite element modelling of muscle forces during mastication” submitted to the Journal of Biomechanics has been reviewed and returned to the authors. The editor of the journal requested some revisions. Both reviewers found the key findings of our results, the three-dimensional distribution of muscle forces during opening, closing, and biting, very interesting and significant. However, they were not pleased with the overall presentation of the paper. The paper was revised according to the reviewer’s suggestions and has now been resubmitted.

A joint paper of Oliver Röhrle, Kylie Foster, Neil Waddell, Iain Anderson, and Andrew Pullan is almost ready for submission to the journal of *Archives of Oral Biology*. This paper describes a methodology that effectively combines motion-capture techniques with mathematical descriptions of motion to accurately track the movement of intra-oral positions during mastication. Its emphasis is on analyzing and investigating masticatory differences between the chewing and non-chewing sides by calculating and comparing trajectories of the right and left lower premolars.

This semester Oliver co-supervised a 4<sup>th</sup> year student who completed a project on modelling the tongue. Part of this project was to develop an anatomical model of the tongue including its complex muscle fibre distribution. Similar principles of active muscle contraction as used for skeletal muscles (compare the model with above mentioned paper on three-dimensional modelling of the masseter muscle forces submitted to the Journal of Biomechanics) were applied to the various different muscle groups within the tongue. The student's abstract got accepted for an oral presentation at the SST'06 (Eleventh Australasian International Conference on Speech Science and Technology), which is held later this year in Auckland. Moreover, a full-length conference paper has been submitted.

Oliver was invited by the New Zealand Institute of Dental Technicians to give the keynote lecture on the masticatory modelling work done at the Bioengineering Institute at their annual meeting on October 14, 2006 in Wellington.

He also submitted conference abstracts to the following conferences:

- ABC6, the Australasian Biomechanics Conference, at the University of Auckland, 15-17 February 2007.
- ISB'07, The International Society of Biomechanics XXI Congress, in Taipei, Taiwan, 1-5 July 2007
- GAMM (The Society of Applied Mathematics and Mechanics) which will be embedded in the ICIAM07 meeting, in Zurich, Switzerland, 16-20 July 2007.

The talk at the ABC6 is entitled "*From Jaw Tracking to Biomechanical modelling of the Human Masticatory System*". The title for the ISB'07 and GAMM is "*Bridging scales: An attempt to incorporate cellular responses within a three-dimensional FEM model of active muscle contraction*".

### 3. MASSEY UNIVERSITY (BY PETER XU)

The Massey team recently had a paper being accepted for journal Engineering Applications of Artificial Intelligence. The abstract is below,

Title: Object-Oriented Knowledge Representation and Discovery of Human Chewing Behaviours

Abstract: Mastication is a complex process influenced by numerous factors including those associated with an individual and the ingested food. Human chewing behaviour can be characterised by measuring mandibular movements and muscles activities during a masticatory sequence or by measuring the particle size distribution and rheological characteristics of the swallowed food mass. To constructively understand the mastication process and assess the mastication performance, a formal description of the chewing behaviour is proposed in this paper. An object-oriented model is developed and described in Unified Modelling Language (UML). The chewing behaviour model is composed of three objects, one for the jaw's physiological apparatus, one for the properties defining the mastication process and foods being chewed, and a further one for the association of the properties. A complete representation of the chewing behaviour is achieved by linking three object models via an additional class for chewing data that is collected experimentally. With the object model, the chewing behaviour is further instantiated by discovering knowledge hidden in the chewing database by data mining. A case study is presented to show the procedure of how the hidden knowledge is discovered and the data mining results are interpreted in the context of food science.

Keywords: Chewing behaviour, food properties, mastication, object-oriented model, knowledge-based system, data mining, knowledge discovery

#### 4. THE UNIVERSITY OF OTAGO (BY IONUT ICHIM)

A paper by Ionut Ichim, Jules Kieser, and Mike Swain from the University of Otago has recently been accepted for publication in Archives of Oral Biology:

*“FUNCTIONAL SIGNIFICANCE OF STRAIN DISTRIBUTION IN THE HUMAN MANBIBLE UNDER MASTICATORY LOAD: NUMERICAL PREDICTIONS”*

I. Ichim, J. Kieser, M. Swain

A common feature of studies of mandibular morphology is the assumption that there is some functional relation between the form of the lower jaw and masticatory stress. It was noted that the local variation in cortical bone thickness in the mandibular corpus appears to be stereotypical among anthropoids. This occurs at sections under the molars, where the lingual cortical plate is thinner than buccal one. In this study we investigate and contrast the strain pattern along buccal and lingual surfaces of the mandibular corpus during mastication using a numerical model of a human mandible. We show that strain distribution differs in alveolar and mid-corpus segments of the mandible and that the latter develops an alternate pattern between the buccal and lingual aspects of the working and balancing sides of the jaw. We then relate the magnitude of these strains to Frost's mechanostat. Our results suggest that the cortical asymmetry of the human mandible is in fact not related to strain patterns generated during mastication.

#### 5. REPORT ON BAD TEETH IN ACADEMIA (FOUND BY JOHN BRONLUND)

I found this and thought the news letter would be an ideal place to bring people aware of it. It is from the "Mini Annals of Improbable Research"

2006-09-11 RESEARCH SPOTLIGHT: Bad Teeth in Academia

Each month we select for your special attention a research report that seems particularly worth a close read. This month's pick:

"Effects of Academic Stress on Oral Hygiene -- A Potential Link Between Stress and Plaque-Associated Disease?" R. Deinzer, D. Hilpert, K. Bach, M. Schawacht, and A. Herforth, Journal of Clinical Periodontology, vol. 28, no. 5, May. 2001, pp. 459-64. (Thanks to Paola Perin for bringing this to our attention.) The authors, who are at the University of Duesseldorf, conclude that:

The study strongly supports the assumption that psychosocial stress may induce neglect of oral hygiene and increase of plaque accumulation.

6. CALL FOR ABSTRACTS AND PAPERS FOR THE BIOMOUTH SYMPOSIUM IN AUCKLAND, DECEMBER 13-14, 2006 (BY JULES KIESER, UNIVERSITY OF OTAGO)

UNIVERSITY  
of  
OTAGO



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## BIOMOUTH SYMPOSIUM AUCKLAND

### MASTICATION RESEARCH: PROGRESS AND HEALTH POTENTIALS

**Scientific sessions: Wednesday 13 December. 9.00 am - 5.00 pm**  
Staff Lounge, Study Centre, East Precinct (Gate 1), Massey University – Albany.

**Planning session: Thursday 14 December 9-12.30**  
Meeting Room, Building 27, Oteha Rohe (Gate 4), Massey University – Albany

The meeting will focus on masticatory research, in particular recent research conducted by the Biomouth group, as well as Australian initiatives. The symposium is organised by researchers in the Department of Oral Sciences at the University of Otago and by the School of Engineering and Technology, Massey University, and is funded by a grant from the University of Otago Research Committee Contestable Funds to Support Research Symposia and Workshops.

The keynote presentation will be by Professor Susan Herring, of the Department of Orthodontics, University of Washington. Susan's long-standing research interests have been focused on masticatory biomechanics in an experimental model, the minipig. Her recent work focuses on the mechanical determinants of cranial bone development. Susan is one of the leading researchers in masticatory research worldwide.

Researchers, clinicians and postgraduate students are invited to attend and present at the scientific programme. The planning session will be limited to Biomouth members.

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# MASTICATION RESEARCH: PROGRESS AND HEALTH POTENTIAL

**Wednesday, 13 December 2006, 9.00 am - 5.00 pm**

Scientific Session

*Staff Lounge, Study Centre, East Precinct, Massey University – Albany.*

## **Morning Sessions:**

9.00: **Introduction**

9.15-10.00: Keynote presentation by the invited overseas speaker:  
**Susan Herring**, University of Washington:

10.00-10.30 **Michael Swain**, Department of Biomaterials, University of Otago:  
*Micromechanical Properties of Teeth*

10.30-11.00 **Morning Tea**

11.00-11.30 **Andrew Pullan and Oliver Röhrle**, Bioengineering Institute, University of Auckland: *An overview on biomechanical computer models of the human masticatory system developed at the Bioengineering Institute.*

11.30-12.30 **John Bronlund, Kylie Foster, and Peter Xu**, School of Engineering and Technology Massey University: *An overview of masticatory research at Massey University - How shit starts to happen.*

12.30-1.45 **Lunch provided**

## **Afternoon sessions:**

1.40-2.10 **Ionut Ichim**, Department of Oral Rehabilitation, University of Otago:  
*Modelling of Fracture Behaviour in Dental Biomaterials*

2.10-2.30 **Jules Kieser**, Department of Oral Sciences, University of Otago: *Intra-Oral pressures during human mastication*

2.30-2.50 **Jim R Jones**, Institute of Technology and Engineering, Massey University:  
*Tunable Mastication Model*

2.50-3.10 **Roger G Lentle**, Institute of Food Nutrition and Human Health, Massey University: *From the dental mill to the pipe; homeostasis of the flow of chyme through the intestine*

3.10-3.30 **Christine Lawrence**, Institute of Food Nutrition and Human Health, Massey University: *The effect of food type on the particle size distributions of the bolus and remaining particles after human mastication*

3.30 - 4.40 **Afternoon Tea and Poster presentations**

4.40 **Closing discussions/wrap-up**

**Thursday, 14 December 2006, 9-12.30:**

Planning session

*Meeting Room, Building 27, Oteha Rohe (Gate 4), Massey University – Albany*