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NEWSLETTER – APRIL 2008

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1. THE 2ND BIOMOUTH SYMPOSIUM – JUNE 23/24 2008 (BY OLIVER RÖHRLE)

After a very successful and interesting first Biomouth Symposium in December 2006, it is with great pleasure that I can announce the dates for our 2nd Biomouth Symposium. We have found a time at which Andrew, John, and Jules claim to be physically present in New Zealand and were able to make some space in their busy calendars. So please mark in your calendars

Monday, **June 23 2008** and Tuesday, **June 24 2008**.

The symposium will, most-likely, be part of the NZIFST (New Zealand Institute of Food Science and Technology) Annual Conference, which is held this year from June 24 – June 26 in Rotorua. John Bronlund has made the initial contact to the organisers of the NZIFST Conference and they seem to be happy to include us in their meeting. There are still some organizational uncertainties, but I will use the Biomouth email list to send out more details as soon as they become available.

The symposium will probably be similar to the last one. We would like to keep it quite informal with plenty of time for talks and discussions. We probably will have discussions on Monday afternoon focusing on future research, aims, and funding opportunities for the Biomouth Research Group. On Tuesday, we plan sessions with scientific talks and some more discussions. Like for the last symposium, we would like to give everyone the chance to present their work without paying any registration fees. However, as mentioned above, I do not want to promise anything as details with NZIFST have not been finalised yet. But as it looks now, there will be no registration fee to attend the Biomouth symposium.

Although it is kind of winter, maybe we can organise, like the last time, a superb South African BBQ with a fantastic selection of wines and coffees as our “conference dinner”.

For more information, please feel free to contact me (o.rohrle@auckland.ac.nz).

2. AN UPDATE FROM THE SCHOOL OF DENTISTRY BIOMOUTH GROUP, THE UNIVERSITY OF OTAGO (BY JULES KIESER)

The best news is that Ionut has been awarded his PhD, having thoroughly impressed his examiners. We wish Ionut, who is currently working in private practice in Tauranga, all the best for a brilliant future, hopefully in academia.

Neil, Gemma and Jules have been looking at the effect of head posture on bite imprints, with special reference to forensic bitemark evidence. We're particularly interested in how the lower and upper incisors engage a large three-dimensional object (such as an arm!). To do this, Gemma constructed a fake arm, complete with radius and femur, in silicone, onto which participants were asked to bite into a wax wafer (our Figure shows Gemma grabbing a mouthful under the watchful eye of Geoff Tompkins). Our initial results then went to Argentina where Valeria Bernal looked at them from a geometric morphometrical perspective. These results are very interesting and suggest different engagement patterns between wafer and arm bites. This will have important implications for our mastication research and we will present these findings at the Dental Morphology Symposium in Greifswald later this year.

3. MODELLING THE TONGUE AT THE BIOENGINEERING INSTITUTE AT THE UNIVERSITY OF AUCKLAND, (BY YIKUN WANG)

I am Yikun Wang, a native Chinese from Shanxi province. I graduated from University of Otago in 2007. In the summer, I was the lucky to do an internship in the Faculty of Dentistry under the supervision of Prof. Jules Kieser and Prof. Mike Swain. At the end of the summer they sent me off to Auckland. Because of the UoA computer system, I had for 4 weeks an identity crisis – can you imagine that I am sharing similar names with 3 strangers at same university (one has even the same birthday as me) and another one is enrolled in the same degree program?! Nevertheless, I successfully became a student of University of Auckland! Currently, I am doing my master research at the Bioengineering Institute. My supervisors are Dr Oliver Röhrle and Prof. Andrew Pullan and guidance from Profs Jules Kieser and Mike Swain. Next, let me tell you my research topic on “Modelling Mechanical Properties of Interlacing Muscle Fibre within the Tongue”.

The biomechanical behaviour of the tongue is relatively poorly understood. This is mainly due to its complicated structure, shape, and its limited visibility. Most of the computational models of the tongue were developed with the aim to investigate the tongue's movement and its change of shape during speaking. However, none of the existing models studies the muscle activity patterns i.e., muscle activity patterns during specific movement like swallowing. This is mainly due to the complicated structure of interlacing muscle groups within the tongue. My research will focus on developing an anatomically-realistic tongue model which is capable of investigating such movements.

One of the main challenges will be to mathematically describe the anatomical feature of interlacing fibres within the tongue. The current implementation of CMISS, the modelling software developed by the Auckland Bioengineering Institute, is only set up to define one set of fibre distributions per computational element. Part of my master will be to modify CMISS in such a way that it will be possible to develop an anatomically-realistic tongue model with interlacing muscle fibre.

In classical continuum mechanics, there exist a vast number of applications that deal with interlacing structures i.e., composite materials such as the steel-reinforced rubber of tyres. To some extend, biological soft tissues can be considered as a fibre-reinforced hyperelastic material. For example, the layers of the arterial wall are composed mainly of an isotropic matrix and two families of fibres. Hence, guided by such work and the more classical work on composite materials, we attempt to modify the strain-energy function of an existing skeletal muscle model to mimic the behaviour of interlacing fibres.

4. ERROR QUANTIFICATION OF VIRTUAL ARTICULATORS, THE UNIVERSITY OF AUCKLAND (BY HARNOOR SAINI)

I have been working with Oliver and Andrew over the past year, starting with my final year BE 4th year project ("Describing Mandibular Movement during Mastication") and continuing with a summer studentship, leading onto my current work. The main aim of this work was to use shape optimisation to recreate cusp geometry, based on the shape and chewing movements of the opposing teeth.

The ability to reproduce a given tooth cusp can be used as a quantitative indication of virtual articulator quality. To achieve this, we first generate "voxel" models of the upper and lower teeth of interest (we chose the right, upper and lower, second molars). We then generate the "generic geometry"; for simplicity our generic geometry or stock was based on the upper tooth and was generated by simply extruding the upper tooth surface by a predetermined distance. Finally, the stock was optimised according to lower tooth chewing trajectories – if the lower tooth voxels occupied the same spatial coordinates as the stock voxels, at any given time during the chewing trajectories, the stock voxels were removed.

The resultant optimised stock shape is then compared to the original upper tooth. The error is given by the L2-norm that is calculated from the distance between the corresponding stock and "our final product" of the corresponding tooth. Our initial error calculations revealed areas of negative distance; this can only occur when the lower molar moves upwards, past intercuspation, into the maxially molar. This is obviously not physically possible and points to errors associated with the virtual articulator model itself. The proposed methodology also reveals functional tooth surfaces in regards to the given chewing trajectories. These functional surfaces could be used as geometric constraints to aid design of dental implants such as crowns and bridges.

I am currently in the process of writing up the methodology and the results of our findings. We anticipate submitting this work to the Journal of Biomechanics.