Université de
Toulouse
(Paul Sabatier)

FORENSICS AND DIAGNOSTICS IN ORTHODONTICS AND MAXILLOFACIAL SURGERY.

An EVAN Consortium Intensive Training Course.

Toulouse, France
25th and 26th
February 2009

The **Department of Biological Anthropology in the University of Toulouse**, Paul Sabatier (UNTO) is a research team in the Faculty of Medicine which is associated with the Natural History Museum of Toulouse. The Department plays an active role in the training programs in medicine (3600 students in the first year of medical school) and in biology (300 students per year).

The department comprises medical doctors and scientists specialising in forensics, genetics, odontology and palaeoanthropology The department is embedded in a variety of collaboration in France (e.g., LIRMM in Montpellier, Natural History Museum in Paris) and overseas (e.g., Transvaal Museum, South Africa) and develops new computer-assisted methods to analyze skeletal morphology, development for palaeoanthropology, maxillo-facial surgery, orthodontics, forensics.

This **EVAN Intensive Training Course (ITC)** will consist of **two brief research reports**, and **two practical sessions** focusing on **practical and technical aspects for the improvement of methods for age assessment and sex determination** from human skeletal remains, from **medical computed tomography (CT) scanners, Cone Beam CT scanners and micro-CT scanners**.

Educational objectives:

Participants will be trained in the use of new CT scanners and new methods for pediatric skeletal age estimation and for sex determination. Research reports and practical sessions will focus on:

- **The use of fully automatic methods for the geometrical analysis and comparisons of 3D skeletal structures;**
- **The use and advantages of Cone Beam CT scanners;**
- **The use of news skeletal collections available in the Forensic Anthropology Research Centre (South Africa) and in the Institut d'Anatomie Normale de Strasbourg (France).**

Application and registration fees

The total tuition fees for the ITC are 160 euros (€). This covers the **classes**, a **conference by Professor Michel Brunet**, the discoverer of "Toumaï" (25th, evening), a **visit of the newly opened Museum of Natural History in Toulouse** (25th, after lunch), **two lunches** (25th and 26th of February) and **one dinner** (26th), **excluding accommodation**.

The closing date for applications has been set for **30th January 2009**. Interested candidates are strongly advised to submit their applications by e mail to braga@cict.fr, as soon as possible, because of the limited number of places available. Late applications will be considered as far as possible, depending on the number of places left and the availability of accommodation.

Only application with a payment of application fee of 160 € will be take into account (Bank: BPOC FONSEGRIVES; ASS INSTITUT PICOT; IBAN: FR76 1780 7000 1901 9195 0749 936; Account #: 01919507499).

Current research: Forensic Anthropology Research Centre (South Africa)

M. Steyn, Department of Anatomy, University of Pretoria

South Africa has a long and proud history of research in Physical Anthropology, and has excellent, well documented modern skeletal collections that can be used for study. These collections are still growing, thus reducing problems with secular trends that can influence the results of studies on older collections. While most research in the past has used basic, standard anthropological methodology, newer and more advanced techniques have found its way into our research. Current projects involve, amongst others, the use of geometric morphometrics to study sexual dimorphism and ontogeny (e.g, development of the scapula, growth of faces). However, we have participated only in two-dimensional analyses, which need to be expanded to include 3-D capability. Bone histological analyses have included age estimation and differentiation between human and animal bones, but micro-CT scanning provides exciting new opportunities for age determination of, for example, bone trabeculae. A recent advancement include one PhD project in which bite force transmission in prognathic and non-prognathic skulls will be compared by means of finite element analysis. We are also looking towards improving methodology used in skull-photo superimposition by using three-dimensional surface scanned images of the skull, in order to help sort out problems with aligning photographs and skulls. It is difficult for any one researcher to keep up with all possible modern techniques that become available, thus paving the way for future more intense collaboration between skeletal biologists and various other experts such as engineers and mathematicians.

Current collaboration with the Institut d'Anatomie Normale de Strasbourg (France)

J. Braga, Department of Biological Anthropology, University of Toulouse

The human skeletal collection in the Institut d'Anatomie Normale de Strasbourg consists entirely of young individuals who passed away in the late 19° and early 20° centuries. A few institutions in Europe have as large a collection of human skeletal remains with such well known age and sex data. The Department of Biological Anthropology in Toulouse has started a research collaboration with the Institut d'Anatomie Normale de Strasbourg. This current collaboration will be presented.

PRACTICAL SESSION 1

FEATURE CURVES, REGISTRATION WITH POLYGONAL MODELS

FEBRUARY 25TH, AFTERNOON (16H00 - 18H30 AM)

VENUE : FACULTÉ DE MÉDECINE DE PURPAN - 41 ALLÉS JULES GUESDE, TOULOUSE

Main Instructor : Dr Gérard SUBSOL

CNRS Senior Researcher

ICAR Project

Laboratoire d'Informatique, de Robotique et de Microélectronique de Montpellier

For the geometrical analysis and comparisons of 3D skeletal structures, some researchers have proposed to use directly **3D feature curves** which give much more information than sparse points. However, it can be difficult to define manually these curves and the result remains user-dependent. So, some researchers in computer science have developed methods **to extract automatically such kind of curves** (often called "crest" or "ridge" lines) **from a 3D image** and they have used them to analyse the shape of a bone or a tooth. They have also showed that crest lines are very close from anatomical lines which are extracted under the supervision of an expert. We present the latest algorithms to compute fully automatically crest lines and we apply them on several anatomical structures (tooth, skull, endocranium) of a database of CT-Scan and microCT-Scan. We show how these lines emphasize the bony or dental structures and can subsequently be applied to the problems of age and/or sex determination.

Participants will also be shown how to **align automatically two surfaces (polygonal models)** with the minimal distance between them and **without any prior choice on its topology**, i.e. without any selection of a specific landmark which may influence the results.

PRACTICAL SESSION 2

CONE BEAM CT SCANNERS VERSUS MEDICAL CT SCANNERS

FEBRUARY 26TH, MORNING (9H30 - 12H00 AM)

VENUE : FACULTE DE CHIRURGIE DENTAIRE, 118 ROUTE DE NARBONNE, TOULOUSE

[*Main Instructor* : Dr Delphine MARET (Dentist) and Dr Jacques TREIL (Radiologist)

Department of Biological Anthropology, University of Toulouse

The compact size and relatively low radiation dosage of the Cone Beam Computed Tomography scanner makes it ideally suited for imaging the craniofacial region, including dental structures. With the increasing accessibility of Cone Beam CT imaging, this modality is emerging as an important new imaging standard for the diagnostic assessments of the bony and dental components of the face. In contrast to the classical CT scanner, the cone beam CT scanner does not image slices, instead its cone shaped beam illuminates a complete volume at once.

The Cone Beam CT combines the advantages (among others) of producing true isotropic voxels at a significantly higher spatial resolution (i.e. smaller voxels) than medical CT scannesr, of being very easy to operate and to maintain (little technician training is required), of a radiation dose is considerably less than with a medical CT.

Volumetric measurements taken on dental tissues with a Cone Beam CT and a micro-CT will be presented. Perspectives will be discussed.

RESEARCH REPORT 2

IDENTICATION (AGE AND SEX)

FEBRUARY 26TH, AFTERNOON (15H00 - 17H30 AM)

VENUE : FACULTE DE MEDECINE DE PURPAN - 37 ALLES JULES GUESDE

Pediatric skeletal age using the skull

J. Braga, Department of Biological Anthropology, University of Toulouse

The purpose of this investigation is, first, to increase the variety of age-related structures theoretically available for pediatric skeletal age estimation and, second, to devise a method that can be applicable from early postnatal age to the end of adolescence with a satisfactory accuracy independent of age. With the aid of cross-validations, the centroïd size of the facial skeleton can be used an age-related variable without any loss of accuracy with increased age, contrary to most of the methods of pediatric age estimation. However, this study was done by using simply 3D landmarks. This new research focuses on size and shape changes on the facial skeleton with the use of polygonal models rather than landmarks or semi-landmarks. The following questions will be addressed: (i) where and when do we observe on the facial skeleton the most significant changes in size and shape? (ii) how can we devise a method for age estimation from these observations in order to be reliable, precise for both early and late juveniles?

Averaging the sexual dimorphism of the 3D architecture of the pelvis

M Faruch, N Telmon; F Dedouit, J. Braga, Department of Biological Anthropology, University of Toulouse

This research proposes to apply new tools for the analysis of sexual variations of the pelvic bone in human populations. The best methods for sex determination from adult skeletal remains involve measurements and visual inspection of the pelvic bone that presents a number of well-known, gender-related morphological differences. However, the major problems for sex determination are that the pelvic bone might be incomplete, or might belong to adolescent individuals. Moreover, there is still a controversy about some anatomical definitions of landmarks and the applicability of the same method by different observers. The purpose of this investigation is to devise an automatic method for sex determination from the analysis of 3D polygonal models of the pelvic bone. Can we find comparable, common trends, by using skeletal samples representing human populations of different geographic origins.