

**Title:** A new tool for medical image processing in biological anthropology and anatomy research

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**Abstract Text:** The use of clinical computed tomography (CT) scans as sources for data in biological anthropology and anatomy research is becoming increasingly common. While it is best to access the original high-resolution scans, the reformatted stacks of low-resolution multiplanar reconstructions are the most commonly available to researchers. Volumetric skeletal models reconstructed from these low-resolution scans can lead to distorted measurements and/or cause problems in subsequent analyses. This study investigates the utility of NiftyMIC, a python-based application, in registering and reconstructing high-resolution volume from multiple stacks of low-resolution scans. We do so by comparing the skeletal measurements taken on the resulting 3D long bone models to those reconstructed using a “classic” semi-automatic segmentation protocol from original low-resolution scans.

CT scans of 33 individuals aged 0 to 16 years were collected from National Taiwan University Hospital. Two sets of linear measurements, one on the original low-resolution volume reconstructions and one on the registered high-resolution volume reconstructions, were collected by two independent investigators. A total of 197 linear measurements (80 lengths and 117 breadths) was collected. Percent differences were used to assess the accuracy of measurements taken on bones using each reconstruction. Technique while technical error of measurement (TEM) and relative technical error of measurement (%TEM) were used to test the reliability of the registration and reconstruction processes and observer errors.

The results showed low and comparable percent differences for original reconstructions (0.688 to 3.801%) and the registered reconstructions (0.202 to 3.47%). Inter-modality TEM and %TEM were 0.089mm and 0.113%, respectively, showing high reliability of the registering technique. Intra- and inter-observer errors were comparable on both types of reconstructions and lower than 1mm and 1% for all TEMs and %TEMs. The registered high-resolution volume reconstructions provided much smoother surfaces and a clean separation

of fusing elements (epiphyses and diaphyses) (Figure 1).

This study demonstrates the utility of a new image processing tool in registering and reconstructing high-resolution volumes from low-resolution clinical CT scans. The application is especially useful in studies of children and juvenile individuals where separation of fusing skeletal elements is required, and in shape analyses, where clean and precise surfaces are beneficial.

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