General information

Data Set Title: “Phantomless calibration dataset”. Data Set Author/s:

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Description

Dataset

The Phantomless calibration dataset is composed of 41 postmenopausal women. 34 of those were selected from the previously published cohort *HFValid* avaiable at: HFValid. The published cohort was previosuly employed for Bologna Biomechanical Computed Tomography (BBCT) that aims to estimate proximal femur resistance to side-falls, taking as inputs the patient calibrated CT scan, the femur segmentation, and some anatomical landmarks (femur head center, greater trochanter, knee rotation center, head direction) [Aldieri 2023]. Each subject's CT scan was calibrated employing the available phantom-based calibration and developped phantomless calibration. The phantomless calibration utilized air, adipose, and muscle tissues, with reference density values of -797, -95, and 38 mg/cm3 extracted from previously performed phantom-based calibration. The HU values for selected tissues were extracted by identifying the peaks from the HU distribution within the VOI and patient-specific calibration lines identified through linear regression between the HU and reference densities. Hence the obtained HU values for each patient are also reported.

A CSV file with subject cohort data (Phantomless_calibration_dataset.csv) is provided. For each subject, the file reports the following data:

- Subject’s ID from 1 to 34
- Subject’s sex
- Subject’s age at the time of the CT scan
- Subject’s height (in cm)
- Subject’s weight (in kg)
- Aqusition year of the CT scan
- Spacing between slices (in mm)
- Slice thickness (in mm)
- KVP (in kV)

- X-ray tube current (in mA)
- Reconstruction kernel
- CT scanner manufacturer
- CT scanner model
- Calibration coefficients obtained from both phantom-based and phantomless calibration - a & b to obtain the radiological density from the HU as: *Density (mg/cm3) = a + b * HU*
- HU values for selected air, adipose and muscle

Script

The aim of this script is to determine the slope and intercept for CT calibration by employing air, adipose, and muscle tissues in order to conduct the calibration process.

The script is a part of Bologna Biomechanical Computed Tomography (BBCT) that aims to estimate proximal femur resistance to side-falls, taking as inputs the patient calibrated CT scan, the femur segmentation, and some anatomical landmarks (femur head center, greater trochanter, knee rotation center, head direction) [Aldieri 2023]. A custom Matlab (release R2022b, The Mathworks Inc) script allows to select a 9 slices-wide volume of interest (VOI) centred at the middle point at the level of femoral shaft between the femoral head and knee centres, and which included air, adipose, and muscle tissues. The script uses the anatomical landmarks that are identified from the CT scans (including femur head centre and knee rotation centre calculated as the mean point between the furthest points of the distal epicondyles in the medio-lateral direction) [Aldieri 2023]. The reference HU values for selected tissues are extracted by identifying the peaks from the HU distribution within the ROI and patient-specific calibration lines identified through linear regression between the HU and reference densities.

Input files

- CT scans: NRRD file (.nrrd) containing volume of selected femur ; The full CT scans should be cropped and saved in NRRD file format with a custom Python script available in Open Access on GitHub Biondi 2021
- Anatomical landmarks: X, Y, and Z coordinates of the landmarks (in the CT reference system) necessary to build the standard local reference system. The coordinates are given for: femurHead (origin) and kneeCentre (hingelocation) [Aldieri2023];

Output

Intercept and slope values for the calibration line, to be used as following: *Density (g/cm3)* RhoQCT = a + b * HU, where: a - intercept, b - slope

Licensing

Reference

Aldieri A, Curreli C, Szyszko JA, La Mattina AA, Viceconti M. Credibility assessment of computational models according to ASME V&V40: Application to the Bologna Biomechanical Computed Tomography solution. Comput Methods Programs Biomed. 2023 Oct;240:107727. Biondi R., Dall'Ollio D., Curti N., Castellani G., A graph Cut

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