# Intra-Operative X-ray Dimensional Calibration Using Orthopaedic Implants

Tsanaka A, Georgilas I, Dagnino G, Dogramadzi S

*Bristol Robotics Laboratory, University of the West of England, United Kingdom*

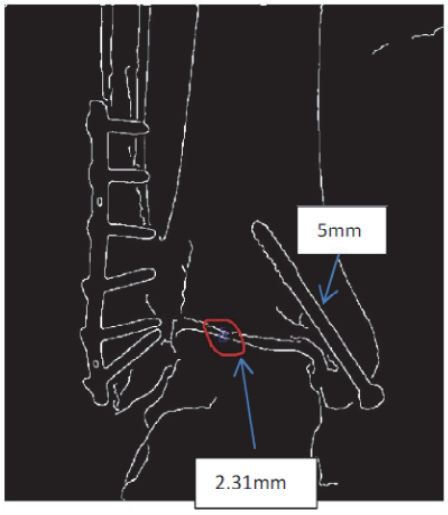


Figure 1

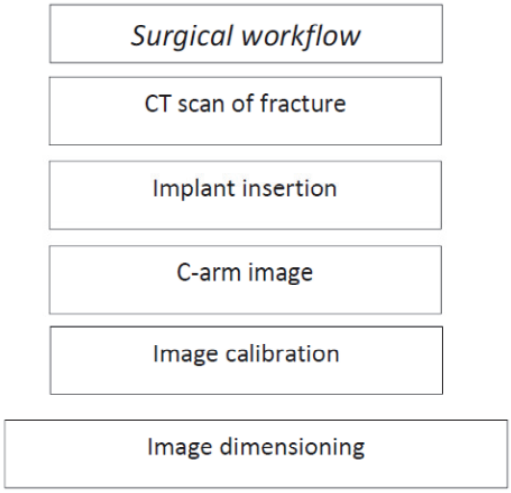


Figure 2

Accurate calibration for intra-operative 2D fluoroscopic images is an important requirement for accurate image guided robot assisted surgery [1]. We propose a new method of obtaining a ground-truth C-arm registration using calibration of implants on fluoroscopic images. Since our research is focused on minimally invasive robot-assisted reduction of joint fractures [2], calibration is the key element for 2D/3D registration. As part of the proposed workflow, a 3D model of the fracture and its fragments will be produced from the DICOM data of a pre-operative CT scan. For the closed management of fractures, the surgeon inserts guide wires and/or screws into the fragments via small incisions before reducing the fracture. A 2D fluoroscopic image is then taken using the intra-operative image intensifier to perform a 2D/3D registration. In order to calibrate the image, we will start by utilizing an external motion tracking system [3] for acquiring the position and orientation of the C-arm. Further on, a dimensional calibration using an image analysis based on our prior research [4] will yield the actual size of the image salient features like e.g. distance between the fragments (see Figure 1). The analysis is based on the size of the implants (guide wires, pins, screws). The proposed image processing algorithm identifies high-intensity (e.g. metallic) well defined objects and matches their dimensions to the implants placed by surgeons. Given the technical specifications of the implants, a reference point can be created as a measuring unit for acquiring the actual dimensions of all the visible contours on the X-ray image. The complexity of registering fragments from 2D to 3D models can be reduced significantly since geometrical size is used to measure and distinguish between the similar looking features.

[1] Markelj, P., Tomaževič, D., Likar, B., & Pernuš, F. (2012). A review of 3D/2D registration methods for image-guided interventions. *Medical image analysis*,*16*(3), 642-661.
[2] Raabe, D., Dogramadzi, S., & Atkins, R. (2012, May). Semi-automatic percutaneous reduction of intra-articular joint fractures-An initial analysis. In *Robotics and Automation (ICRA), 2012 IEEE International Conference on* (pp. 2679-2684).
[3]NDi Polaris Spectra, http://www.ndigital.com/medical/products/polaris-family/
[4] Tsanaka, A., Tarassoli, P., & Dogramadzi, S. (2014). Pre-Operative Planning of Femoral Neck Fractures: A Tool for Accuracy. Proceedings of the Hamlyn Symposium on Medical Robotics 12-15 July 2014, Imperial College, London, UK