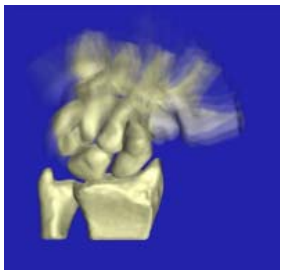
The moving wrist joint

Detection of motion patterns in the wrist joint from 4D CT-images

An internship position is available at the Biomedical Engineering and Physics department of the Academic Medical Center (AMC). In our group, new treatment and diagnostic procedures based on innovative physical techniques are developed. Research is performed by a multidisciplinary team that includes physicists, engineers, mathematicians, medical doctors, biologists, and chemists.



Background

The human wrist joint consists of eight carpal bones and numerous ligaments permitting a large variety of motions of the hand. In a pathological situation the biomechanical interaction between bones might be disturbed. The motion patterns of the carpal bones during motion of the hand contain important information for diagnosis of wrist pathology.

In current radiological practice of diagnosing patients with wrist problems often plain (2D) radiographs are acquired. For skeletal pathology static imaging modalities are in most cases sufficient to diagnose fractures and dislocations of bony structures. For dynamic abnormalities these static images are insufficient. Video fluoroscopy is able to visualize dynamic abnormalities. However, the limitations of this method are that the video frames are only 2D projections of a 3D phenomenon and do not quantify or visualize motion patterns in 3D.

To allow for imaging of real time 3D motion of the carpal bones in the wrist, we recently developed a 4D-CT protocol.

Research description

The challenge of this project is to extract dynamic motions patterns from the 4D-CT images and evaluate the accuracy of the imaging chain and the associated image analysis methods. An important issue limiting the accuracy of the motion pattern detection is motion blur. The specific topic of this internship is to establish the relation between motion blur in the 4D images and the accuracy of the motion pattern detection. To this end you will develop and implement a method to impose controlled motion to carpal bones and measure bias in the detection of motion parameters with 4D image analysis methods.

Requirements

We are looking for a Bachelor or Master student with general knowledge of physics and instrumentation. For this internship some experience with programming (preferably C or C++) is a prerequisite. The duration of the internship can be adjusted according to the curriculum.

Learning outcome

The student will gain knowledge in the field of Medical Imaging and develop technical skills, general laboratory skills, and data analysis skills. Being part of an interdisciplinary and international research group the student will acquire competences including: (1) collaboration, (2) scientific writing, and (3) presentations.

References

1. Carelsen, B; Jonges, R; Strackee, SD; Maas, M; van Kemenade, P; Grimbergen, CA; van Herk, M; Streekstra, GJ. Detection of In Vivo Dynamic 3-D Motion Patterns in the Wrist Joint. IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING 56(4), 1236-1244, 2009.
2. Foumani, M; Blankevoort, L; Stekelenburg, C; Strackee, SD; Carelsen, B; Jonges, R; Streekstra, GJ. The effect of tendon loading on in-vitro carpal kinematics of the wrist joint. JOURNAL OF BIOMECHANICS 43(9), 1799-1805, 2010.

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