

Realizing passive four-dimensional CT scans

Development of an automated passive wrist movement device

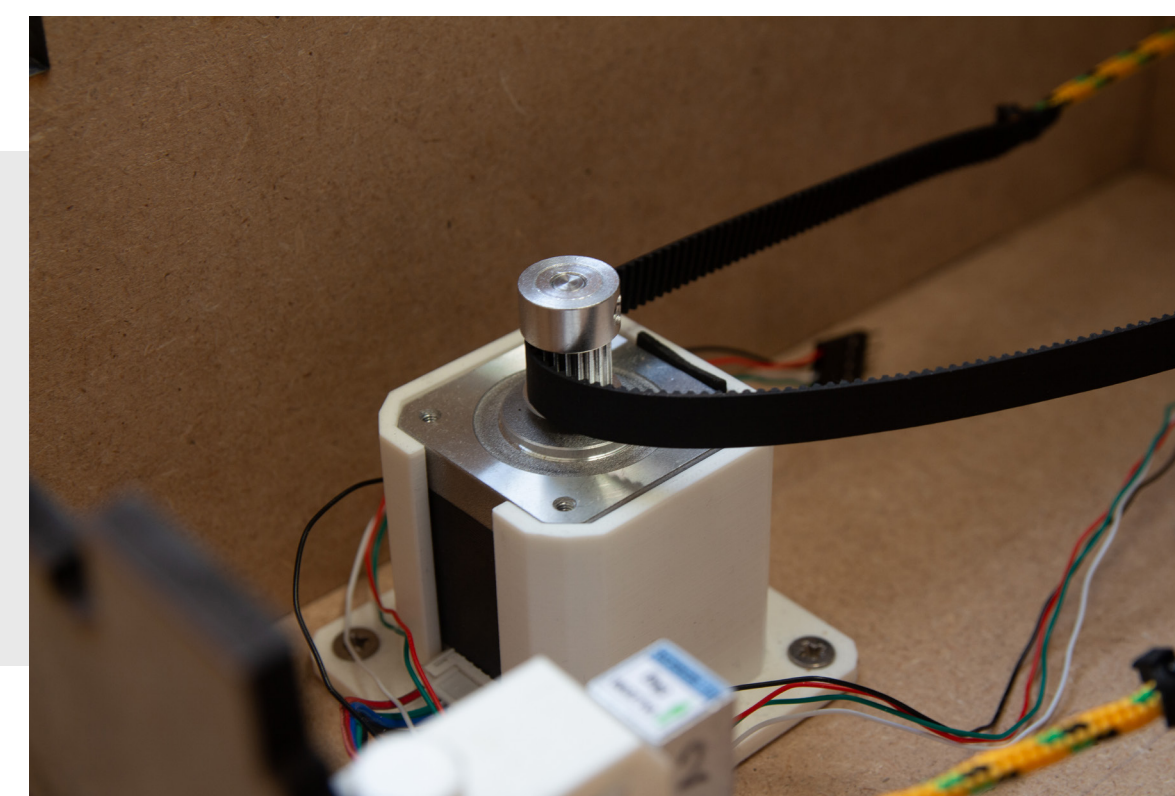
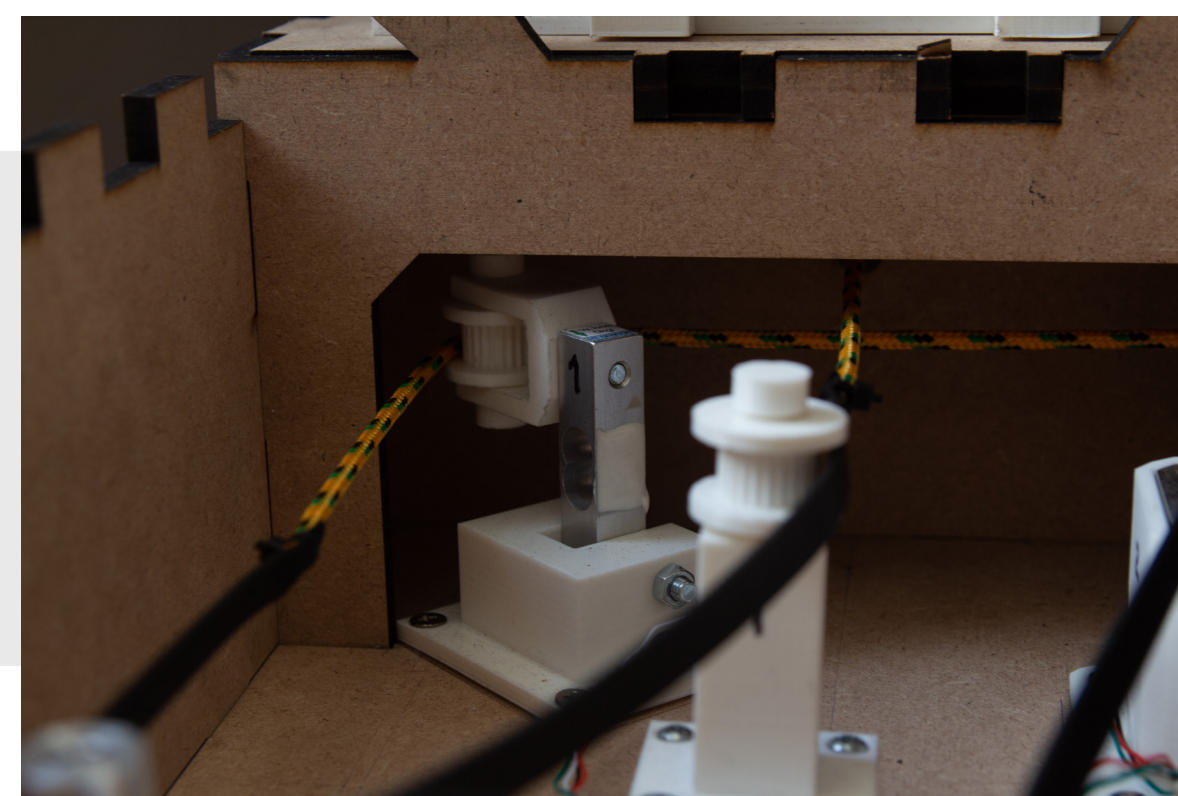
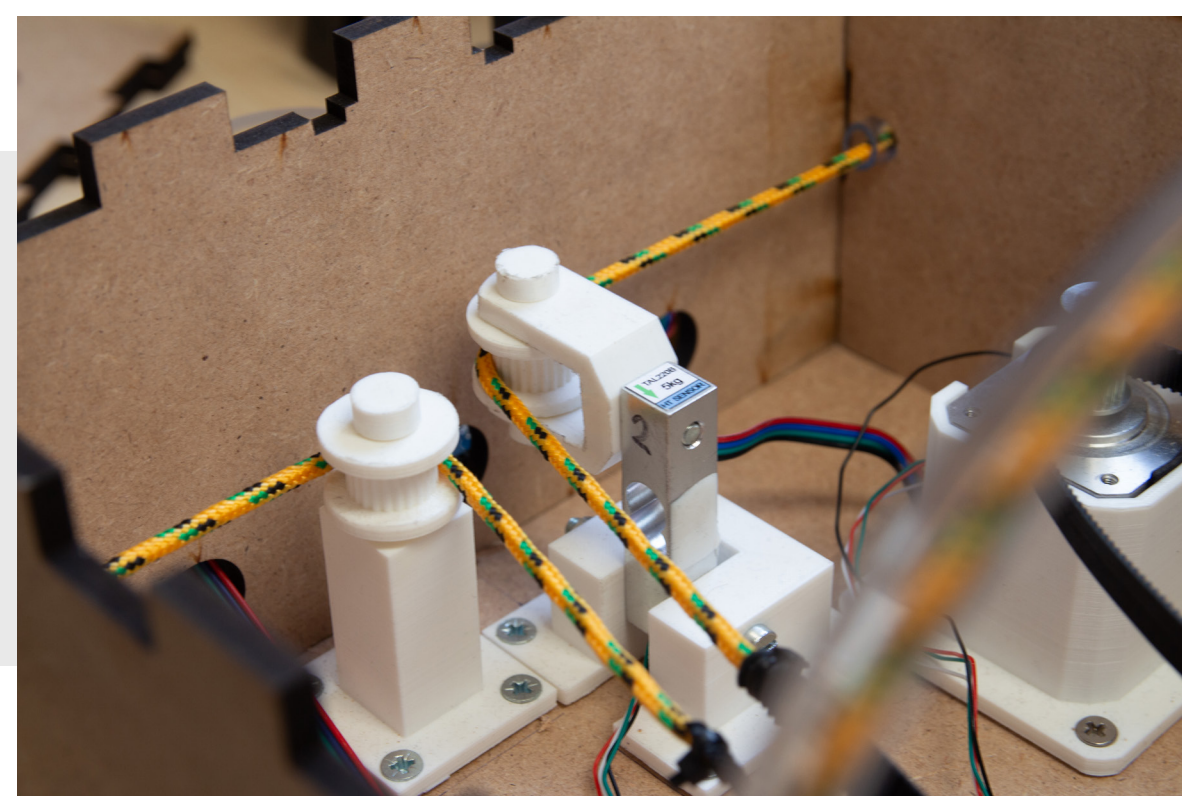
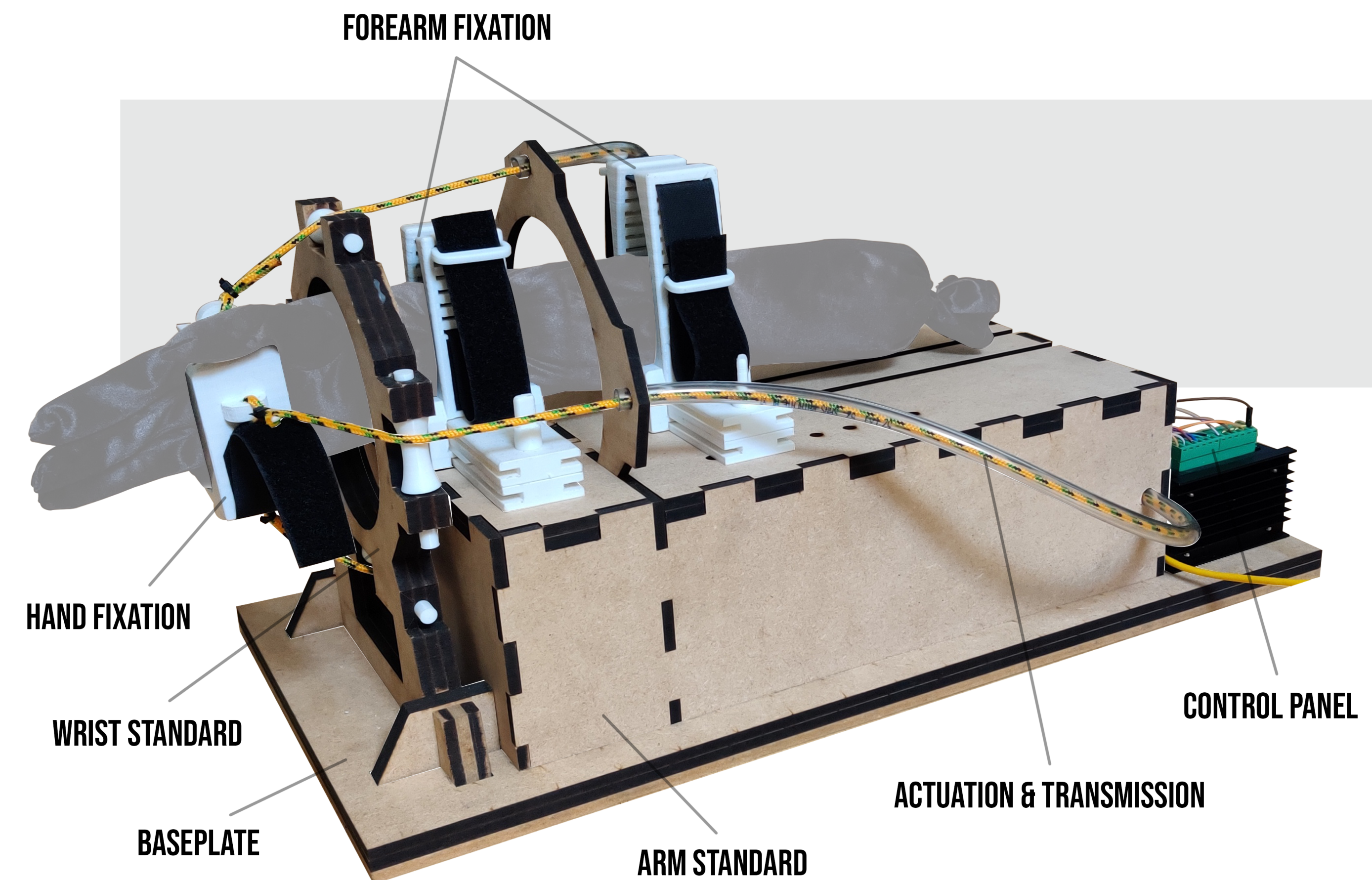
At this moment the wrist is mainly scanned and reviewed statically in 3D. However, it is desirable to see what happens on a CT scan during movement of the wrist (the fourth dimension), as many clinically significant, debilitating and painful wrist pathologies are dynamic in nature and cannot be fully appreciated statically.

Recently it has become technically feasible to have patients actively move their wrists in specific directions to create the fourth dimension, so that the wrist can be reviewed dynamically. However, according to S. Buckens active movements of the wrist are less desirable than passive movement as patients are typically able to (partly) compensate for wrist instability using forearm muscles, masking potentially significant pathology.

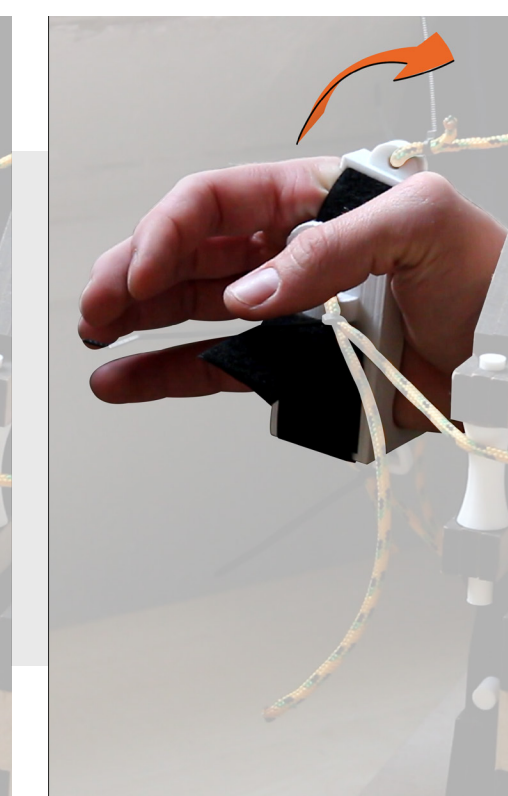
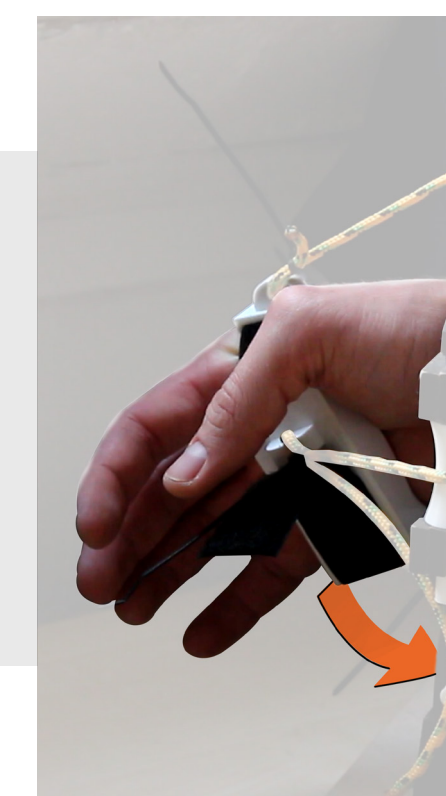
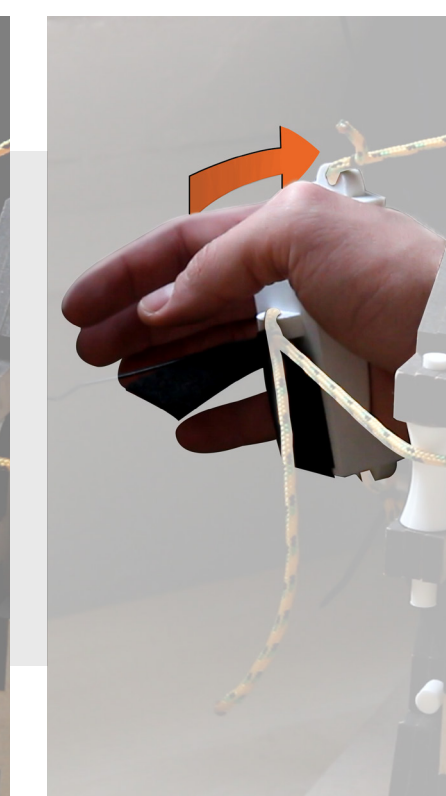
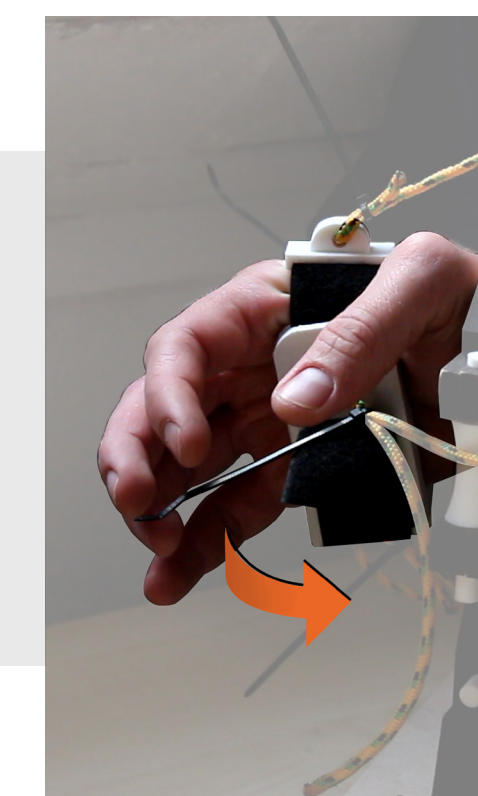
During this project a device has been developed which is able to facilitate passive movement of the wrist. An integrated cable-pulley system (see images below) in combination with NEMA 17 stepper motors facilitates the actuation of the device and therewith the passive wrist movements. Rubber Bowden tubes in combination with nylon cables are used to establish the transmission of the actuator to the hand fixation. Within the system, a feedback system of load cells is integrated which measures

the real-time cable tension. This system prevents the motors from pulling the patient through their comfortable range of motion (ROM) and possibly injuring them. When using the device, patients are able to place their forearm on top of the arm standard and push it all the way to the front (through the two rings). The 3D printed forearm fixations are used to fixate the patient's forearm at two places (near the wrist and near the elbow). Also, the patient's hand is fixated by another 3D part. All fixations make use of velcro straps to account for the variation in arm- and hand size.

The electronic system integrated in the arm standard and the back of the product facilitates the automated part of the device. The control panel functions as the connection between the actuation and transmission of the device and the user, which is in the case either the radiologist or radiographer.



Actuation and transmission



Passive wrist movements

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Development of an automated passive wrist
movement device for 4D CT scans
25th of May, 2020
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