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Control system for knee rehabilitation device

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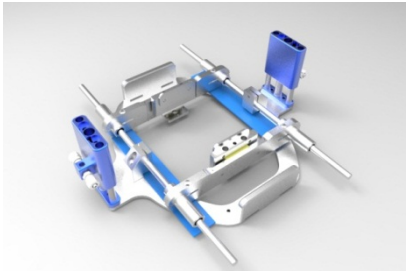
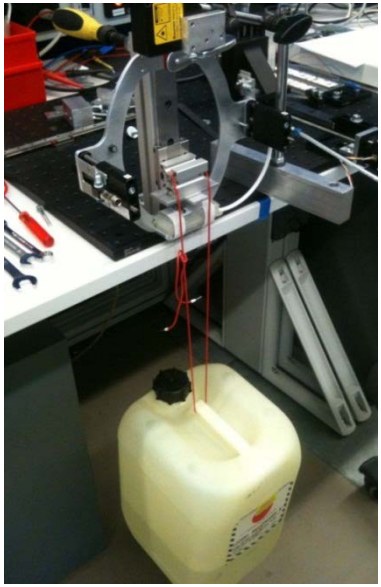
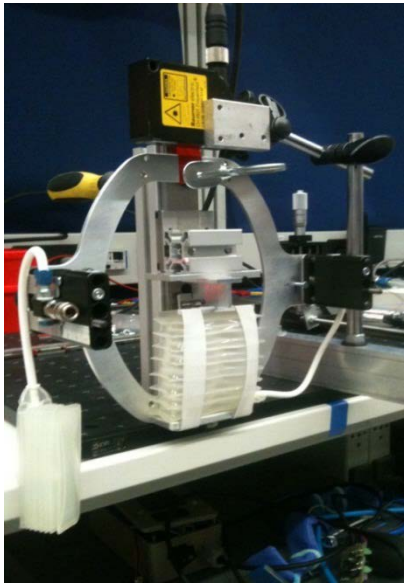


Picture 1: Improved linear bearing

Background: During knee surgery it is practically impossible to avoid tissue injuries within and around the knee joint. This leads to scar tissue formation and tissue adhesion within the knee joint. To minimize the scar tissue formation and the tissue adhesion, the institute for laboratory technology ILT developed a device which mobilizes the patella (knee cap) during the rehabilitation phase. This knee rehabilitation device should enable the patient to conduct therapy more often than only during therapy sessions with the physiotherapist. The existing rehabilitation device can be controlled to move the patella. However it has not yet been investigated if the mobilization process is reproducible.

Objective: The aim of this project was to develop and realize a controlling strategy for a more reliable and reproducible therapy process.
In the end the device should be brought to a stage of development which can be tested in clinical studies.





Picture 2: Characterization of gripper actuation system

Solution: In order to increase controller performance, mechanical parts had to be optimized first. A new linear bearing was manufactured and integrated to solve the stick-slip issue.

A prototype force sensor based on preprinted (cathode sputtering) thin layer strain gauges was built and tested successfully.

Since the existing system was controlled with an Arduino Mega2560 also the new controlling system was realized on this platform. A control algorithm was programmed based on position measurements.

A connection box was realized as interface between sensors and the Arduino controller. Force sensors can be also connected to this box at a later stage. The controller performance is not satisfactory yet. However this thesis provides a very good basis for further development.