Basic requirements: speeds of 30cm/s or greater at end-effector, continuous 100% duty cycle forces of 50N up to 200N, somehow inexpensive, acceleration of end-effector of at least 5m/s^2 when unloaded.

Actuator questions

- Are linear motors easy to control? Do they behave well in general terms? (bandwidth, peak acceleration, position control?). Which kind of linear actuator might be suitable for this application?
- Are brushless motors worth their cost (vs DC motors) if maintenance and efficiency are not important?

Power transmission elements without backlash: our device requires force bandwidth of 20Hz or more, that's why backlash is a critical issue (current reHaptikKnob backlash of 0.8° and 10Hz of force bandwidth)

- If a rotatory motor (DC or brushless) was chosen, a power transmission component would be necessary to convert speed into torque (more or less 12:1 or 20:1 ratio, output torque less than 4Nm). Between harmonic drives and worm and wheels which one do you think is better? Any other suggestions?
- Drive belts are elastic: is this a kind of backlash which will affect our force bandwidth? Do drive chains have backlash too?

Tips on measuring the velocity (linear or angular) of a device with low noise? (encoder, integrating de signal of an accelerometer, deriving the signal of a potentiometer, tachometer..) (requirements: linear velocity: 50cm/s or greater; angular velocity 800 s^{-1})

RELab Project Guidelines

This document contains valuable information and guidelines related to your bachelor/semester/master thesis at the Rehabilitation Engineering Lab. Please read these instructions carefully and see your assistant if you have any questions.

Administration
- at the beginning of your project you will receive a USB stick containing these guidelines, a template and tutorial for your report, and a PDF file with the signed project description
- keep a backup of all relevant data on this USB key
- fill in the key request form and bring it to your assistant in order to obtain a key to your office
- handle the material you receive with care. If you notice that anything is malfunctioning or broken, please inform your assistant immediately. This is not a problem, but allows us to act quickly to repair/replace these components
- in case of an incident, contact your assistant immediately and call 888 (ETH emergency hotline) if necessary

Software (if applicable)
- you will receive access to a desktop PC which contains the software most commonly used in the group. If you require any project specific software, contact your assistant.
- comment and document your code from the beginning to make it understandable to other project members. Each file should contain a header with the name of the creator, date, current version and short description of the contents
- prepare dedicated programs to initialize and test hardware components. Acknowledge successful steps or errors with indicators or meaningful text messages
- implement and document safety features (e.g. low-level position and velocity monitors)
- create an executable or backup your code whenever you have a stable version which can serve as a demo. Instruct your assistant on how to use the demo
- place a copy of all project relevant files on your USB key, and hand them in with a documentation file at the end of the project

Hardware Setups (if applicable)
- make sure that your assistant properly instructs you on how to use any hardware necessary for your project. Handle your hardware with care, and double-check with your assistant if you are uncertain about cabling or configuring components
- if you are working in a student room, protect your equipment by locking it in a drawer or locker. Always leave a key to the equipment with your assistant, and inform him/her where the equipment is located
- document your setup (written instructions with pictures of connectors and cabling schematics; if you have unused connectors on your system or PC, place an empty connector in them or tape them over) and boot procedure of your system
- document any critical details the user should be aware of when running the system
- implement mechanical safety features (e.g. travel limitations) to protect your setup from software failures

Demos

We regularly have lab visits during which we demonstrate ongoing activities, and a demo is the best way of showing your achievements during/after the project defense. Prepare a demo as soon as possible during the project, write up a users guide and instruct your assistant on how to run the demo and where to find the necessary material. See "Software" for further instructions".

Intermediate/Final Presentation
The intermediate and final presentation are an integral part of your project. While the intermediate presentation is more informal with the aim of discussing the progress and milestones, and making necessary adjustments, the final presentation will be graded according to a template which is available from your assistant. This template covers all aspects of your presentation, including presentation style, contents, keeping time, etc. Use the RELab PPT/Keynote template for your presentation, which is available from your assistant (USB stick)

Report
- project reports are to be written in english using the provided LaTeX template. An introduction to scientific writing with LaTeX and vector graphics is provided as a Tools Course at D-MAVT by the Rehabilitation Engineering Lab. If you cannot attend this course, work through the course material provided on this USB key, or coordinate with your assistant to arrange for an introductory tutorial
- the USB key you received contains a PDF file of the signed project description. Include it at the beginning of your final report
- hand in your report at the latest one week before your final presentation. After the final presentation you will have one more week to make corrections and final adjustments.
- instructions on how to structure your report are given in the LaTeX tutorial and on your project description sheet

Pictures/Figures
- all figures are to be provided as vector graphics in PDF format. Most programs can export this format. Assure readable text size (Matlab allows you to set a minimal font size in the export preferences window – a typical value is 14 Pts)
- pictures should have a resolution of at least 250 dpi (100 dots per cm). The picture should be provided in sufficient size and quality to be reused on a poster of size A0. Provide high resolution originals on your USB stick whenever possible. A tutorial on basic image processing using open source tools is also provided on this USB stick

End of Project
- place all documents, programs, report files, and other project relevant items on the USB key provided to you at the beginning of the project, respecting the provided folder structure, and hand it over to your assistant. Include a readme.txt file which describes the folder contents
- return the key(s) to your office
- hand over all equipment to the assistant, and inform him/her if there are any issues with any of the components that require special attention

5/03 - 9/03 : Finish the calendar. Make requirements and how to measure them.

12/03 - 30/03 : Design of the different options for the robots. Evaluation of the options.

2/04 - 4/04: Preparation of the presentation with JC and Gassert.

5/04 : Presentation.

10/04 - 13/04 : making the CAD model of the chosen option

16/04 - 4/05 : Ordering necessary components. Manufacturing (machining) necessary pieces. Assembly and construction of the robot