Armeo®Power

1. Background information

After an injury, functional recovery takes place; on one hand, due to spontaneous recovery, on the other, therapy induced. The goal of technology-assisted rehabilitation is to support recovery by complementing conventional therapy approaches.
Scientific evidence shows that the key factors to successful recovery are:

- Functional task-specific training
- Active participation
- Self-initiated movements
- Training intensity: repetitions x effort
- Motivation
- Feedback

The **ArmeoPower** is the world's first commercially available robotic arm exoskeleton and has been specifically designed for arm and hand therapy in patients with severe to moderate impairments in arm and hand function. With its Assist-as-needed arm support, the ArmeoPower provides highly repetitive training even for severely affected patients. The advantages of the ArmeoPower therapy are:

- Early rehabilitation with highly repetitive training for severely affected patients
- Improved therapy efficiency by reducing therapist's physical effort
- Arm Weight Support in an extensive 3D workspace
- Augmented Performance Feedback and Virtual Reality with motivating exercises to train activities of daily living (ADLs)
- Assist-as-needed support provided by the robotic arm exoskeleton that can be adapted to the patients' capabilities.
- Assessment Tools for an objective analysis and documentation of the patient's progress

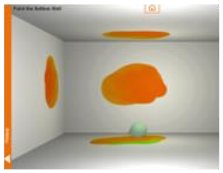
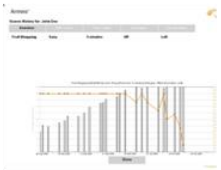
2. What is the Armeo®Power?

The ArmeoPower has been specifically designed for patients with severe to moderate movement impairment who have little to no voluntary activation of their arm muscles yet. The ArmeoPower is based on the ARMin technology developed at ETH Zurich and University Hospital Balgrist under the supervision of Prof. R. Riener.

The ArmeoPower is a robotic device intended for the rehabilitation of patients with severe to moderate impairments in upper limb function. The ArmeoPower provides functional training to improve upper limb function.
The ArmeoPower consists of a motorized arm orthosis (exoskeleton), which supports the weight of a patient's arm and assists the patient's movements as needed during functional upper limb exercises. The ArmeoPower can also be used to provide passive mobilization of the patient's upper limb. The device includes a pressure sensitive handgrip or a motorized hand

module assisting hand opening and closing (ManovoPower). The arm orthosis acts as input for the device-specific therapy software. The software includes motivating, game-like exercises which simulate activities of daily life and are presented to the patient on a computer screen. The ArmeoPower allows the therapist to adapt the therapy parameters via a user interface to individualize therapy and address patient-specific needs. The ArmeoPower can objectively assess joint range of motion and isometric torque, movement workspace and movement quality, and produce therapy reports.
The ArmeoPower must always be used under supervision of an occupational therapist, physiotherapist or other medical professional, who has received training in operating the ArmeoPower and has read and understood the User Manual of the ArmeoPower.
The ArmeoPower is intended for the rehabilitative treatment of patients with severe to moderate impairments in upper limb function. These impairments can be caused by different diseases, including, but not limited to, neurological diseases, for instance stroke.

3. What does the Armeo®Power consist of?

Arm Movement		- Exoskeleton - Safety zone & ROM
Individual Settings		- Arm Weight Support - 3D Workspace - Robotic support - Exercises
Patient's Performance		- Augmented Performance Feedback - Active movements/ passive movements
Assessments		- A-ROM - A-MOVE - A-GOAL - A-FORCE
Patient's Data		- Scores - Reporting Tools

The ArmeoPower consists of an **exoskeleton** (6 degrees of freedom – 7 if ManovoPower is installed), which is linked to a **software** on a screen. You can adjust the exoskeleton and several software parameters individually to your patients' needs and according to the therapeutic goal of the patient.

The exoskeleton will "guide" or "control" the **arm movements**. For safety reasons you have create some safety zones at the beginning, to prevent the exoskeleton from colliding with the patient.

Several **individual settings** can be adjusted or selected, like the arm weight support which supports the movement of the patient against gravity during the movement, the 3D workspace or several exercises according to the patient's ability.

Moreover, the ArmeoPower (exoskeleton) has sensors which measure the **patient's movements**. Patient's performance and feedback are shown on the screen within Augmented Performance Feedback exercises. The software contains an extensive library of game-like movement exercises supported by a virtual-reality training environment that is both motivating and informative, clearly displaying the functional task along with immediate performance feedback.

Besides functional exercises, the system also provides **assessments** designed to assess the range of motion, 3D workspace, isometric force and coordination of patients. Built-in sensors record the active arm movement at each joint during all therapy sessions and the performance data is stored in the computer, where it can be used to assess and document the patient's progress, to determine the next appropriate challenge and to promote optimal therapy conditions.

All these details (**Training Data**) will be saved in the reporting tool, which you can export.

4. How are we going to use the Armeo®Power in a training session?

First, we need to **Prepare the Patient and the ArmeoPower**. **Personal data** like username and impaired arm are entered in the software. For ArmeoPower, also the height and weight of the patient are required in order to calculate the mass of the arm, for providing a correct gravity compensation. The anatomical joints should match the mechanical joints. Therefore, **adjusting the exoskeleton** should be done in following order: shoulder – elbow – wrist. Select the **safety zone** as close as possible to the body. The safety zones prevent collisions between the device and the patient.

Then, **arm weight support** is selected and entered in the software. The arm weight support should be sufficient enough for the patient to be able to perfom specific tasks without compensatory movements while allowing many repetitions and yet kept to a minimum to ensure a challenging training session.

Then we will prepare the session (**Session setup**). This session setup procedure will be done a systematic way, step by step, to make it time efficient and to avoid missing a step. To **define the 3D workspace**, you have to conduct the initial assessments A-ROM (1D workspace) and A-MOVE (2D, 3D workspace). For A-**ROM**: determine the range of motion in each joint you want to exercise in later; consider that the patient will only be able to move within these defined limits in the exercises. While **creating the therapy plan**, select appropriate **exercises** aligned with training goals or the patient's ability (1D/2D/3D, included joints, movements) as well as appropriate exercise parameters (difficulty level, duration, visual detail). **Mobilization** and **Assessment** tools may also be included in the therapy plan.

Once all is ready, we will start **Training** according to the selected therapy plan, which can also include assessments along with exercises.

Once the training session is finished, we **Bring the patient out** of the ArmeoPower.