ARMin and VR in Peripersonal Space
To Improve Rehabilitation of Paretic Arm
Katherine Grace August\textsuperscript{1,3}, Marco Guidali\textsuperscript{1,2}, Verena Klamroth-Marganska\textsuperscript{1,2}, Robert Riener\textsuperscript{1,2}

\textbf{Motivation}

\begin{itemize}
\item To improve arm rehabilitation.
\item To develop and evaluate biologically inspired control of robot and virtual reality hand eye coordination exercises.
\end{itemize}

\textbf{Methods}

Sensors record ipsilesional limb. Program robot control, virtual agents.

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{3rd_person_agent.png}
\caption{3rd Person Agent, 1st Person Agent}
\end{figure}

\textbf{Cognitive System Robot}

1. Sensors record tasks performed with ipsilesional limb.
2. Therapist establishes boundaries.
3. BioFeed ARMin guides paretic arm with personalized control program.

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{figure_4.png}
\caption{ARMin Personalized Programming}
\end{figure}

\textbf{Plasticity-based Approach}

\begin{itemize}
\item Target brain regions associated with voluntary motor control.
\item Personalize robot support and virtual reality agent.
\item Observation and Imitation exercises.
\item Sensory Motor stimulation and feedback.
\item Reach and grasp, manipulation.
\end{itemize}

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{figure_1.png}
\caption{Target Brain Regions}
\end{figure}

\textbf{Tasks}

Observation and Imitation with robots in virtual reality Peripersonal Space.

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{figure_2.png}
\caption{Activities of Daily Living}
\end{figure}

\textbf{Conclusion}

Recodings of the ipsilesional limb may be used to program ARMin and VR for personalized therapy to support plasticity-based approach – targeting neural regions associated with voluntary control of movement.

Katherine Grace August, Ph.D.
Sensory-Motor Systems Lab
Sonneggstrasse 3, CH-8092 Zurich
Phone: +41 44 632 93 63
Email: katherine.august@mavt.ethz.ch

\textsuperscript{1} Sensory-Motor Systems Lab
Inst. for Robotics & Intelligent Systems
Dept. of Mechanical & Process Eng.
ETH Zurich
http://www.sms.mavt.ethz.ch

\textsuperscript{2} Spinal Cord Injury Center
University Hospital Balgrist
Faculty of Medicine
University of Zurich
http://www.balgrist.ch

\textsuperscript{3} Whitaker International Scholar
www.whitaker.org