Stroke is the leading cause of serious, long-term disability among American adults. Each year over 700,000 people suffer a new or recurrent stroke, and nearly 500,000 (71%) survive with some form of enduring neurological disability. Upper extremity (UE) motor impairment is a common consequence of stroke and often produces significant challenges for patients as they engage in everyday instrumental activities of daily living. However, research has shown that such lost UE function can be recovered or improved via systematic, repetitive and task-oriented motor training. Virtual reality (VR) enhanced motor training is an emerging therapeutic modality that can serve to deliver UE motor training tasks within consistent, yet modifiable simulated functional environments that mimic real world challenges. As well, game features can be integrated into the VR training to enhance motivation and promote therapeutic focus and adherence.

Among the numerous VR tasks that we have created and tested for UE training aims, the “Reaching Task” was designed to require patients to reach for multiple virtual targets in 3D peripersonal space with synchronized forearm and hand movement on their paretic side (Fig. 1). Target positions in 3D space are positioned in a semi-sphere zone that is calibrated to each patient’s current range of motion (Fig. 2).

A clinical test using this VR task (along with 3 others) was conducted with five post-stroke patients at USC. Each subject attended 12 two-hour training sessions to practice the four VR UE tasks. Specific to the Reaching Task, three kinematic metrics were derived: movement efficiency (ME), movement speed (MS) and performance time (PT), based on continuous capture of the hands 3D position across all trials. In addition to examining performance change over time, we explored various methods for efficiently visualizing this type of data. One method mapped each target’s 3D position onto one zone in a pitch-yaw 2D chart that was then coordinated with the test measures to generate a performance map. Trial or session performance can be visualized via a single performance map while progress can be visualized from a set of performance maps across different time points. The ME-performance maps of one subject (#103) across five training sessions, at a 50% arm extension ratio, are in Fig. 3. The performance and progress of ME can be visualized through these five performance maps via a unique color/position coding approach. Further, the trend line of average ME for each session also showed progressive improvement over time as shown in Fig. 4. Similar improvements were found for MS and PT measures and the data from these patients will be presented at MMVR along with the details of our visualization approach.