# EYE-TRACKING GUIDANCE FOR EXOSKELETON REHABILITATION

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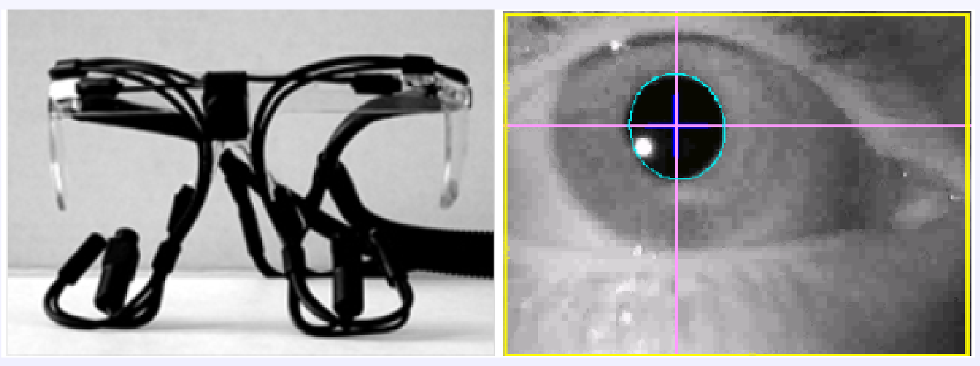
## Abstract

Eye-tracking systems are playing an increasingly important role in assistive robotics as hand-free interaction interfaces for motor impaired people, but no noticeable applications have been developed so far for enhancing the robotic assisted training in functional rehabilitation. In this poster it is proposed a new gaze based control to provide active guidance to the upper limb movement, through a robotic exoskeleton, in the functional rehabilitation of pick and place tasks. Experimental results on healthy subjects demonstrate the feasibility of the proposed approach and the breakthrough that the system introduces in the field of eye-based rehabilitation systems.

## Eye-tracking

Although in recent years eye tracking has entered in its fourth era [2], most of the eye-based robotic application are in the field of assistance robotics and not in the field of training of lost motor abilities. This research tries to fill the gap. Moreover issues related to the eye-based applications, like Midas touch, are successfully solved.



## Neurorehabilitation through gaze

Neuromotor rehabilitation is one of the great challenges of robotic applications. Rehabilitation robots can be used to restore or train visuomotor performance in patients following brain or nerve damage, either through therapy or through active assistance in daily activities. There are two types of use of assistance robotics systems:

- *pure assistance use* (e.g. meal assistance) to help motion impaired people in Activities of Daily Living (*ADLs*);
- *training use* for rehabilitation purposes [1].

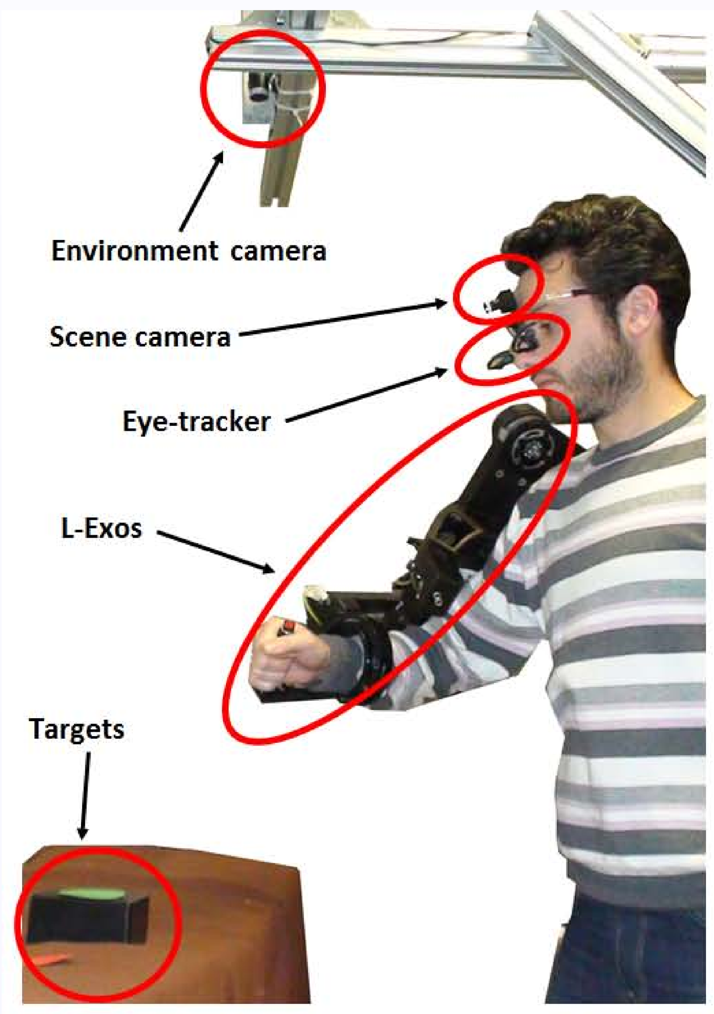



Fig. 1 Complete system

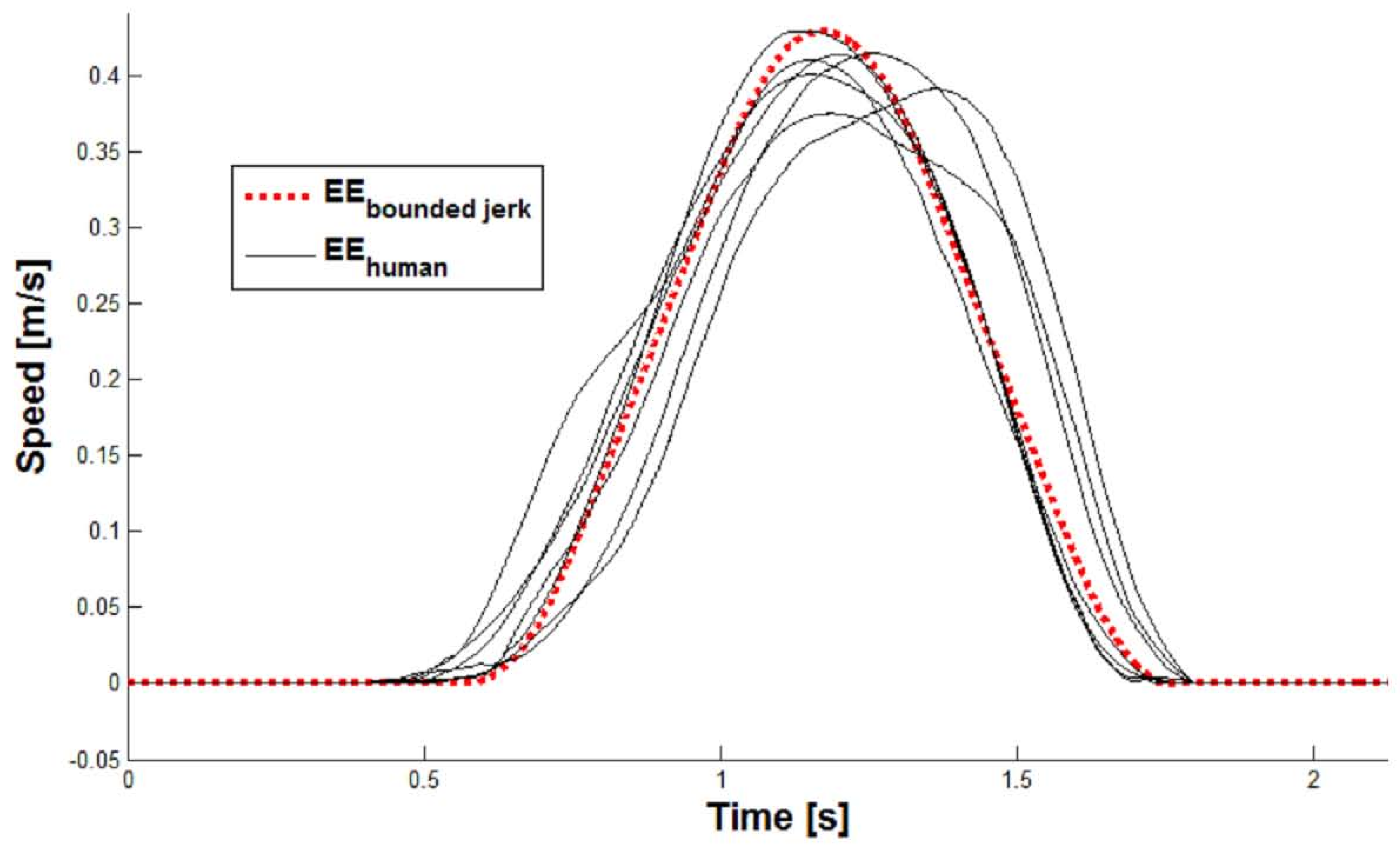



Fig. 2 The full lines represent the speed profile of a healthy subject's hand in reaching task, starting and ending in the same points. The red dotted line represents the same task using the proposed trajectory planning method.

In this research an upper limb exoskeleton, the *Light Exos* designed and manifactured at *SSSA*, is used as a training robot with triggered active assistance (the complete system is reported in Fig. 1).
The patient, with the *Light Exos* motor support, has to reach a target previously selected by gaze. In this way the patient's self-initiated movement is encouraged and this is thought to be an essential requirement for motor learning.
There are scientific premises that training performed not only at the level of movement, but also involving higher cognitive function, such as visuo-motor coordination, might be beneficial in neuromotor recovery from stroke.
To complete fullfill the task two important features have been proposed:

- a new *online synchronized bounded jerk trajectory planning method* with which it is possible to simulate the human arm movements (Fig. 2). It has been demonstrated [3] that in reaching tasks the human arm movements are comparable to minimum jerk trajectory planning;
- *full safety work condition*, thanks to the fast calculation of a proxy point [4] given the target position. Proxy point, defined as the nearest workspace point to the target, allows to avoid dangerous conditions for the subject.

## References

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[3] T. Flash, N. Hogan, 'The Coordination of Arm Movements: An Experimentally Confirmed Mathematical Model' in *Neuroscience, vol. 7, pp. 1,688-1,703*, 1985.

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