

# Skyfarer: A Mixed Reality Shoulder Exercise Game

Marientina Gotsis\*  
University of Southern California

Vangelis Lympouridis  
University of Southern California

David Turpin  
University of Southern California

Fotos Frangoudes  
University of Southern California

Somboon Maneekobkunwong  
Rancho Los Amigos National  
Rehabilitation Center

Maryalice Jordan-Marsh  
University of Southern California

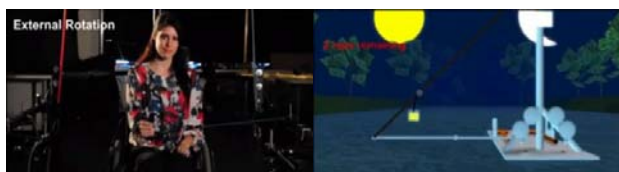
## Abstract

*Skyfarer* is a mixed reality shoulder exercise game developed for prevention and treatment of shoulder pain for individuals aging with spinal cord injury. We are adapting a shoulder exercise protocol that has been evaluated in a randomized clinical trial [Mulroy et al. 2011]. This demonstration will showcase a second-generation integrated exercise hardware and software system. The system consists of an adjustable metal rig outfitted with GameTrak sensors that are attached to interchangeable TheraBands and free weights. The rig can accommodate individuals with various types of manual wheelchairs and can be adjusted for arm length. The GameTrak sensors provide three-dimensional movement data to the calibration and exercise software application that was developed in Unity Engine 3.5.



**Figure 1.** *Skyfarer 0.5a* (left and bottom right) was evaluated in real-time in a biomechanical study (top right)

*Skyfarer* has emerged after iterating numerous prototypes that incorporated individual elements of a shoulder exercise protocol using a first-generation metal rig [Gotsis et al. 2012]. *Skyfarer* requires calibration of the game to the physical dimensions and muscle strength of individual players. Player profiles can be stored and the number of required repetitions per exercise can be manually adjusted before playing.



**Figure 3** Resistance-training exercises in *Skyfarer 0.5a*

*Skyfarer 0.5a* incorporates the following parts of the exercise protocol: external rotation, rowing, diagonal pull-down and vertical lift exercises. This version has been evaluated in a biomechanical study conducted at Rancho Los Amigos National Rehabilitation Center. The virtual environment immerses players

into an adventure inspired by Pre-Colombian mythology inspired by the landscapes of South America. With each exercise, players prepare, propel and lift their vessel into water or air, collecting energy that can be used during breaks between exercise sets. *Skyfarer 0.5b* includes Microsoft Kinect as input for free-form movement segments of the game, such as drawing and improved calibration, animation and movement cuing.



**Figure 2.** Each movement is first shown to the player and then calibrated for their abilities and body dimensions before playing

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\* email: mgotsis@cinema.usc.edu