CLAIMS

1. A processor implemented method for interpreting neural interplay involving proprioceptive adaptation during a dual task paradigm, the method comprising:

monitoring, by one or more hardware processors, a subject performing the dual task paradigm, wherein the dual task paradigm is performed by the subject with a lower limb, from both limbs of the subject, at predefined intervals for a predefined time period for interpreting the neural interplay involving proprioceptive adaptation in the lower limb of the subject while performing the dual task paradigm,

wherein the dual task paradigm comprises:

simulating integration of a Single Limb Stance (SLS) functionality test for postural stability and a single limb collision avoidance task, in an adaptive Virtual Reality (VR) environment provided to the subject, wherein the subject is positioned on an object in the VR environment equipped with one of a VR head set for immersive environment and a display screen for non-immersive environment, Electromyography (EMG) sensors placed on muscles associated with ankle joints of both limbs of the subject, and wherein motion of the subject while performing the dual task paradigm is sensed using a set of motion sensors placed at a predefined distance from the object;

receiving, by the one or more hardware processors, data associated with the subject performing the dual task paradigm, wherein the data comprises metadata of an avatar of the subject from one of the VR head set when in immersive environment and the display screen when in non-immersive environment, data from the EMG sensors and data from the set of motion sensors, to estimate a plurality of model parameters for the subject, wherein the plurality of model parameters comprise a Centre of Mass (CoM) sway, a collision rate, a trajectory smoothness variation and a muscle co-activation of the subject for the dual task paradigm; and

interpreting, by the one or more hardware processors, the neural interplay involving the proprioceptive adaptation in the lower limb based on a task that subject prioritizes among postural stability and collision avoidance during the dual task paradigm, wherein the task is prioritized based on variation in the CoM sway, the collision rate, the trajectory smoothness variation and the muscle co-activation of two muscles including Tibialis Anterior (TA) and Lateral Gastrocnemius (LG) estimated for the subject in accordance with the dual task paradigm performed by the subject at the predefined intervals for the predefined time period.

2. The method of claim 1, wherein the variation in the CoM sway, the collision rate, the trajectory smoothness variation and the muscle co-activation provides interpreting of the neural interplay involving proprioceptive adaptation in the lower limb of the subject is used to design personalized rehabilitation therapy for the subject.
3. The method of claim 1, wherein the dual task paradigm integrating the SLS functionality test for postural stability and the single limb collision avoidance task in the adaptive VR environment provided to the subject further comprises:

instructing the subject to stand on the object with both the limbs resting on the object;

displaying to the subject, using the VR head set, trail of control lines and obstacles of a predefined height approaching the avatar in the VR environment;

instructing the subject to lift the lower limb for a SLS posture when both limbs of the avatar touch a control line in the approaching trail and hold the SLS posture till an obstacle in the trail is crossed over by the avatar; and

notifying the subject of success or failure in maintaining the SLS posture and crossing of the obstacle along with a feedback to the subject for corrective action improve the collision avoidance in the SLS posture.

4. A system for interpreting neural interplay involving proprioceptive adaptation during a dual task paradigm, the system comprising:

a memory storing instructions;

one or more Input/Output (I/O) interfaces; and

one or more hardware processors coupled to the memory via the one or more communication interfaces, wherein the one or more hardware processors are configured by the instructions to:

monitor a subject performing the dual task paradigm, wherein the dual task paradigm is performed by the subject with a lower limb, from both limbs of the subject, at predefined intervals for a predefined time period for interpreting the neural interplay involving proprioceptive adaptation in the lower limb of the subject while performing the dual task paradigm,

wherein the dual task paradigm comprises:

simulating integration of a Single Limb Stance (SLS) functionality test for postural stability and a single limb collision avoidance task, in an adaptive Virtual Reality (VR) environment provided to the subject, wherein the subject is positioned on an object in the VR environment equipped with one of a VR head set for immersive environment and a display screen for non-immersive environment, Electromyography (EMG) sensors placed on muscles associated with ankle joints of both limbs of the subject, and wherein motion of the subject while performing the dual task paradigm is sensed using a set of motion sensors placed at a predefined distance from the object;

receive data associated with the subject performing the dual task paradigm, wherein the data comprises metadata of an avatar of the subject from one of the VR head set when in immersive environment and the display screen when in non-immersive environment, data from the EMG sensors and data from the set of motion sensors, to estimate a plurality of model parameters for the subject, wherein the plurality of model parameters

comprise a Centre of Mass (CoM) sway, a collision rate, a trajectory smoothness variation and a muscle co-activation of the subject for the dual task paradigm; and

interpret the neural interplay involving the proprioceptive adaptation in the lower limb based on a task that subject prioritizes among postural stability and collision avoidance during the dual task paradigm, wherein the task is prioritized based on variation in the CoM sway, the collision rate, the trajectory smoothness variation and the muscle co-activation of two muscles including Tibialis Anterior (TA) and Lateral Gastrocnemius (LG) estimated for the subject in accordance with the dual task paradigm performed by the subject at the predefined intervals for the predefined time period.

5. The system of claim 4, wherein the one or more hardware processors are configured to interpret the variation in the CoM sway, the collision rate, the trajectory smoothness variation and the muscle co-activation provides interpreting of the neural interplay involving proprioceptive adaptation in the lower limb of the subject is used to design personalized rehabilitation therapy for the subject.
6. The system of claim 4, wherein the one or more hardware processors (104) are configured to:

instruct the subject to stand on the object with both the limbs resting on the object;

display to the subject, using the VR head set, trail of control lines and obstacles of a predefined height approaching the avatar in the VR environment;

instruct the subject to lift the lower limb for a SLS posture when both limbs of the avatar touch a control line in the approaching trail and hold the SLS posture till an obstacle in the trail is crossed over by the avatar; and

notify the subject of success or failure in maintaining the SLS posture and crossing of the obstacle along with a feedback to the subject for corrective action improve the collision avoidance in the SLS posture.

7. One or more non-transitory machine readable information storage mediums comprising one or more instructions which when executed by one or more hardware processors causes a method for:

monitoring a subject performing the dual task paradigm, wherein the dual task paradigm is performed by the subject with a lower limb, from both limbs of the subject, at predefined intervals for a predefined time period for interpreting the neural interplay involving proprioceptive adaptation in the lower limb of the subject while performing the dual task paradigm,

wherein the dual task paradigm comprises:

simulating integration of a Single Limb Stance (SLS) functionality test for postural stability and a single limb collision avoidance task, in an adaptive Virtual Reality (VR) environment provided to the subject, wherein the subject is positioned on an object in the VR environment equipped with one of a VR head set for immersive environment and a display screen for non-immersive environment, Electromyography (EMG) sensors placed on muscles associated with ankle joints of both limbs of the subject, and wherein motion of the subject while performing the dual task paradigm is sensed using a set of motion sensors placed at a predefined distance from the object;

receiving data associated with the subject performing the dual task paradigm, wherein the data comprises metadata of an avatar of the subject from one of the VR head set when in immersive environment and the display screen when in non-immersive environment, data from the EMG sensors and data from the set of motion sensors, to estimate a plurality of model parameters for the subject, wherein the plurality of model parameters comprise a Centre of Mass (CoM) sway, a collision rate, a trajectory

smoothness variation and a muscle co-activation of the subject for the dual task paradigm; and

interpreting the neural interplay involving the proprioceptive adaptation in the lower limb based on a task that subject prioritizes among postural stability and collision avoidance during the dual task paradigm, wherein the task is prioritized based on variation in the CoM sway, the collision rate, the trajectory smoothness variation and the muscle co-activation of two muscles including Tibialis Anterior (TA) and Lateral Gastrocnemius (LG) estimated for the subject in accordance with the dual task paradigm performed by the subject at the predefined intervals for the predefined time period.

8. The one or more non-transitory machine readable information storage mediums of claim 7, wherein the variation in the CoM sway, the collision rate, the trajectory smoothness variation and the muscle co-activation provides interpreting of the neural interplay involving proprioceptive adaptation in the lower limb of the subject is used to design personalized rehabilitation therapy for the subject.
9. The one or more non-transitory machine readable information storage mediums of claim 7, wherein the dual task paradigm integrating the SLS functionality test for postural stability and the single limb collision avoidance task in the adaptive VR environment provided to the subject further comprises:

instructing the subject to stand on the object with both the limbs resting on the object;

displaying to the subject, using the VR head set, trail of control lines and obstacles of a predefined height approaching the avatar in the VR environment;

instructing the subject to lift the lower limb for a SLS posture when both limbs of the avatar touch a control line in the approaching trail and hold the SLS posture till an obstacle in the trail is crossed over by the avatar; and

notifying the subject of success or failure in maintaining the SLS posture and crossing of the obstacle along with a feedback to the subject for corrective action improve the collision avoidance in the SLS posture.