Applications of Artificial intelligence in prosthetics and orthotic rehabilitation

Introduction :

Human is the most intelligent creature in the planet for their brain power and neural network. The human brain is extremely complex with more than 80 billion neurons and trillion of connections . Simulation scales can array from molecular and genetic expressions to compartment models of subcellular volumes and individual neurons to local networks and system models . Deep Neural Network nodes are an over simplification of how brain synapses work. Signal transmission in the brain is dominated by chemical synapses, which release chemical substances and neurotransmitters to convert electrical signals via voltage-gated ion channels at the presynaptic cleft into post-synaptic activity. The type of neurotransmitter characterizes whether a synapse facilitates signal transmission (excitatory role) or prevents it (inhibitory role). Currently, there are tenths of known neurotransmitters, whereas new ones continuously emerge with varying functional roles. Furthermore, dynamic synaptic adaptations, which affect the strength of a synapse, occur in response to the frequency and magnitude of the presynaptic signal and reflect complex learning/memory functions, (Spike time dependent plasticity) . Recently, evidence has found that surrounding cells, such as glia cells that are primarily involved in 'feeding' the neurons, can also affect their function via the release of neurotransmitters .

This new vision of "tripartite synapses" composed of perisynaptic glia in addition to pre- and postsynaptic terminals certainly makes this one of the most exciting discoveries in current neurobiology . The functional loss due to amputation, spinal cord injury, brachial plexus injury or traumatic brain injury resulting loss of connection from brain to extremity and those residual/weakened extremities are not able to function as of healthy/intact limb. These lost structure & functions of extremities were being replaced by fitment of prosthetics and orthotic devices or rehabilitation aids. The conventional prosthesis which is a mechanical device only provide the basic function, similarly Orthosis provides the support to weaken parts not fully with out completely mimicking the lost section. The concept of biomechatronic is a sub-discipline of mechatronics. It is related to develop mechatronics systems which assist or restore to human body gave the prosthetics and orthotics concept to a new direction. A biomechatronic system has four units: Biosensors, Mechanical Sensors, Controller, and Actuator . Biosensors detect intentions of human using biological reactions coming from nervous or muscle system. The controller acts as a translator

among biological and electronic structures, and also monitors the activities of the biomechatronic device .

Mechanical sensors measure data about the biomechatronic device and relay to the biosensor or controller. The actuator is an artificial muscle (robot mechanism) that produces force or movement to aid or replace native human body function. The areas of use of biomechatronic are orthotics, prosthesis, exoskeleton and rehabilitation robots, and neuroprosthesis. Robots are the intelligent devices that easily fulfill the requirements of cyclic movements in rehabilitation, better control over introduced forces; accurately reproduce required forces in repetitive exercises and more precise in different situations.