A Low-cost Bionic Transradial Electromyographic Prosthesis Using Transformer-Based Deep Learning Algorithms

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Current commercial and research-grade prosthetics lack fine motor movements and have limited degrees of freedom. These functional limitations force the amputee to compensate, which causes other health problems, further diminishing their quality of life. Additionally, commercial prosthetics are expensive with roughly only 5% of people being able to afford prosthetic devices. Given these problems, we propose a transformer-based deep learning algorithm to read surface electromyography (sEMG) signals and a 3D-printed transradial prosthetic capable of independent finger movement. The transformer model employs attention mechanisms to overcome prior constraints: mode complexity, high computation, and latency, and considering both spatial and temporal information. The overall cost of the prosthetic is less than $450, more than 160 times cheaper than commercial prosthetics. Furthermore, our prosthetic utilizes high-accuracy servo motors which allow for fine motor movements and has 15 degrees of freedom, more than three times that of current research-grade prosthetics and 15 times that of commercial-grade ones. Additionally, the mechanical prosthetic has a grasp speed of over three times faster than other state-of-the-art prosthetics and is comparable in weight to the human hand.

Awards Won:
Third Award of $1,000