A Step Towards Solving Foot Pain: A Novel Shoe with Customizable Magnetic Levitation to Reduce Ground Reaction Forces through Pronation-Targeted Computer Vision Pose Estimation, Year 3

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216,262,500. That’s the number of steps an average human takes over their lifetime, yet the shoes that humans use for this have not evolved over time and are found to have major flaws such as inadequate arch support causing overpronation, poor dampening of ground reaction forces, and generic sole support causing chronic pain. Implementation of a novel shoe with Computer Vision-based Subtalar Pose Estimation to customize the embedded Magnetic Levitation eliminates these problems. The computer vision determines the pronation and uses it to determine the placement of the magnetic levitation to provide arch support and reduce excess pronation. These magnets were arranged in a grid-like pattern spread across the arch based on musculoskeletal gait simulations. The project was tested in two phases: modeled and real-world application. To test efficiency across various angles of pronation, the shoes underwent a set of simulated foot drop tests using three 3D printed foot models to test 3 different angles of pronation, a crutch with 12 kg of weight (i.e. a simulated leg) and an accelerometer to record the deceleration as a measure of the efficiency of the cushioning. After over 6000 trials, the modified shoe was found to be 34% softer, 15% cheaper than the unmodified shoe, and 38% lighter than the average shoe. The real-world testing, performed by 376 participants, found that the new shoe was softer, cheaper, and lighter than their current shoe with an average rating of 9/10. The data suggest that this novel shoe, in conjunction with the pose estimation system, is a highly practical, affordable, and effective solution to the problem facing the rapidly expanding $246.07 billion footwear industry and the potential to revolutionize a necessity in every human’s life across the globe.

Awards Won:

Second Award of $2,000