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A ROBOTIC SHOE FOR MONITORING AND MANIPULATION OF THE FOOT CENTER OF PRESSURE FOR REHABILITATION AND DIAGNOSTIC

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Summary: The use of biomechanical devices in a form of a shoe for rehabilitation and clinical treatment in various fields is a common, well-established approach. However, this approach has several drawbacks and limitations as it requires a long learning cycle to determine the optimal shoe adjustment for specific patient needs. The biomechanical device adjustment usually requires many iterations to achieve the patient-specific optimal solution, which leads to a less accurate solution, suffer the lack of dynamic changes, and misses the flexibility to support the patient's specific situation, such as different stepping surfaces and fatigue.

The system developed is a robotic-biomechanics shoe composed of a special in-soles that is equipped with embedded pressure sensors enabling it to continuously monitor the ground reaction forces (GRF) and the foot center of pressure (COP) while standing, or walking/running. The COP and GRF information can be stored and later be used for analyzing diagnosing gait and instability events accruing during locomotion. In addition, we developed a robotic shoe-sole that contains miniature electrical motors that are manipulating two biomechanical hemispheres that changes and manipulate the forces acting on the foot and the lower limb. We then use the shoe insole COP readings as a feedback to manipulate the two hemispheres in the robotic sole resulting in a manipulation of the GRF.

We have develop a Robotic Rehabilitation System (RRS) in the form of a shoe which allows shifting of the Center of Pressure (COP) trajectory dynamically and fit patient specific needs. The COP is being measured continuously by an in-soles system (SoleMate) enabling an accurate dynamic fit of an optimal COP, autonomously and continuously using the RRS in a controlled closed loop to enable an efficient novel treatment method for patients suffering with neuromuscular and orthopeadic disorders.