AiF Project 17615N

Sensor Controlled Running

The task faced by PFI in conducting the AIF research project 17615N bearing the title "Sensor Controlled Running" was to design a measuring platform which would permit the forces acting on the foot during physical activity (specifically during running) to be recorded and made available for subsequent analysis. Moreover, this project also examined biomechanical, sensor-related, and electronic possibilities for detecting the consequences of excessive strain, for example in the case of Achilles tendon complaints.

At the conclusion of the project it can be stated that the investigated biomechanical parameters for differentiation between healthy runners and test persons with Achilles tendon complaints do indeed appear appropriate because the statistical characteristics of the two groups show considerable deviations. Additionally examined shoe modifications had effects on the characteristics in both groups of test persons. Modifications to the running shoes of the test persons with Achilles tendon complaints exerted a positive influence on the biomechanics of running.

The tiring effect can also be deduced from individual parameters, because significant differences could be found between the values acquired at different measuring times. It is thus also established that biomechanics of running will change with increasing tiring of the runner. The electronic units designed in the project proved suitable for detection of the desired parameters and for making them accessible for subsequent offline evaluation. This was confirmed by PFI's project partner, the Institute for Sport and Exercise Science at the University of Stuttgart.

The mobile system developed in the project could already be used to distinguish between healthy runners and those suffering from Achilles tendon complaints and to issue a warning signal where appropriate.

Although the maximum accelerations at the Achilles tendon do not change in all three spatial directions with increasing tiring, a difference is found in the time up to maximum acceleration after setting down of the heel. Maximum accelerations occur earlier at the distal end of the Achilles tendon than at the proximal end. No deviations in the resonance frequency could be found with increasing fatigue. No vibration damping occurs along the Achilles tendon.

PFI has developed several measuring units permitting acquisition of 26 sensor signals necessary for movement analysis. Here the temporal resolution of many existing portable measuring systems is even exceeded. The units designed as long-term data loggers are only about the size of two chewing gum packages and can store the motion data of a runner over periods of hours for subsequent evaluation.

The data that can currently be recorded by the sensor are: Electromyograms (EMG), angular rates, foot contact, spatial orientation, and, of course, acceleration.

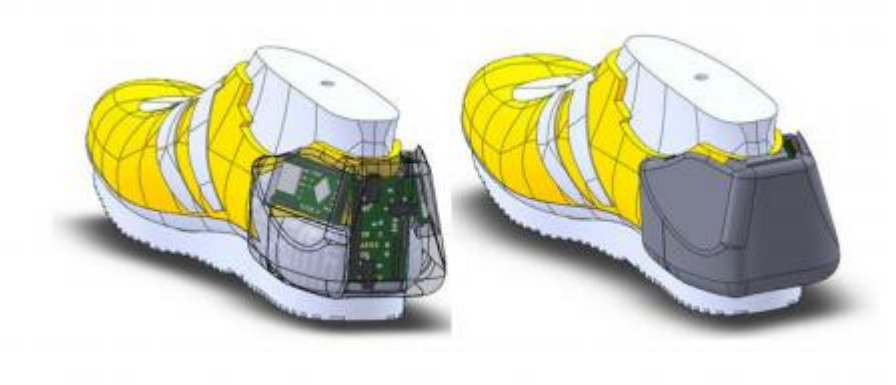

Figure: Heel counter design concept: The counter accommodates the electronics and could be built to permit ready attachment to and detachment from appropriately made shoes

Some of the systems developed in this project are currently being used in an ongoing study. The systems are undergoing further optimisation while the search for additional applications continues. Adaptation to specific requirement or special sensors is feasible.

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