INTRODUCTION

Foot pressure measurement sensors can be either ground mounted or placed inside shoes. The two systems produce different results because the insoles translocate and bend with the shoe, and therefore do not provide the same inertial frame of reference for forces that a ground plate does. Ground based pressure plates on the other hand have historically been quite small, causing runner's to target the plate, visibly altering their natural rhythm. To assess these variations one needs high-speed sensors (500hz) of similar construction and density, positioned both inside and outside the shoe, synchronized in time covering a large floor area (400cm x 40cm).

METHODS

Twenty subjects (23±3 yrs) ran at 5.0 ±0.2 m/s down a 30m x 0.4m EVA matt with a total of 32 368 resistive pressure sensors in the middle (324m length. The ground sensors were contained in two computer-synchronized 2m RSscan pressure plates placed in series between electronic stopwatch timing gates 10.5m apart connected to a Timetronics scoreboard with a 0.01s resolution. Subjects each ran 4 barefoot trials, and 4 with custom made flat-soled running shoes. All the shoes tested had instrumented insoles wired to a battery powered 8Mb data-logger strapped to the lumbar region. Data was synchronized with a 5V signal sent along a cable between the plates, and simultaneously radioed via FM to the insole data-logger.

RESULTS AND DISCUSSION

The results of the three systems are very different. Barefoot pressure patterns show little heel contact with more medial-lateral motion. Insole pressures are widely distributed but with less center-of-force variation than the shoe print; which progresses more from heel to toe.

Figure 2: (a) Barefoot, (b) insole, and (c) flat-soled running shoe maximum pressure contour maps and 500hz center of pressure points measured at comparative speeds.

SUMMARY

The simultaneous measurements of insole pressure and ground pressure using a high sampling frequency of 500 Hz and resistive sensor density reveal considerable differences in timing and force distribution. Large differences in pressure patterns are seen between insole and ground-based sensors that are both directly in contact with the foot anatomy. There are also large differences between pressures measured simultaneously in and under the shoe, which means that insole measurements are influenced rather more by shoe design than foot anatomy.