California	Kansas
501 Park Way	307 Plymate Lane
Mill Valley, California 94941	Manhattan, Kansas 66502
Telephone: (415) 781-6080	Telephone: (785) 539-6305
Facsimile: (415) 358-4340	Facsimile: (415) 358-4340

SURFACE SYSTEMS & INSTRUMENTS, LLC

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Custom Test Equipment • Mobile Technology Solutions

PRECISION OF SSI LASER PROFILING SYSTEMS IN DETECTING LOCALIZED ROUGHNESS

Not all surface profiling systems are created equal. Most of the commercially available laser profiling systems have a limited ability to precisely measure and report the exact location and dimensions of localized roughness. The advanced design of SSI's data collection system, and the proprietary filtering techniques developed by SSI's PhD level engineers, have resulted in an unprecedented ability to characterize the longitudinal location and physical dimensions of localized roughness. To prove the ability of its lightweight and high speed profiling systems in detecting localized roughness, SSI developed a set of artificial bumps with defined changes in bump heights. SSI's profiling systems and several competitor devices were run across the artificial bumps placed at random locations on a controlled test surface. A summary of the research and results is presented below. Figure 1 shows one of the artificial bumps—an eight foot long surface with equally spaced .25" bumps that increase up to a thickness of 1.75" and then decrease on the back side of the bump to the initial .25" thickness.

Figure 1: Artificial Bump for Testing Profiling System Accuracy in Detecting Localized Roughness

SSI's lightweight and high speed profiling systems were run across the artificial bump at various speeds. Figure 2 shows the dimensions of the bump as measured by SSI's systems. The blue line represents the actual dimensions of the bump, with the "X" axis showing the longitudinal station of the bump (positioned from station 293 to 301), and the "Y" axis showing the height of the bump in .25" increments from 0 to 1.75 inches. The green, red and turquoise graphs depict the profile of the bump as reported by SSI's system over three consecutive data collection runs. As apparent from Figure 2, the profile generated by SSI's system precisely tracks the bump dimensions and longitudinal location of the artificial bumps. Also note the precise repeatability of the SSI's systems multiple runs over the same surface, as demonstrated by the tight clustering of the trace lines on top of one another.

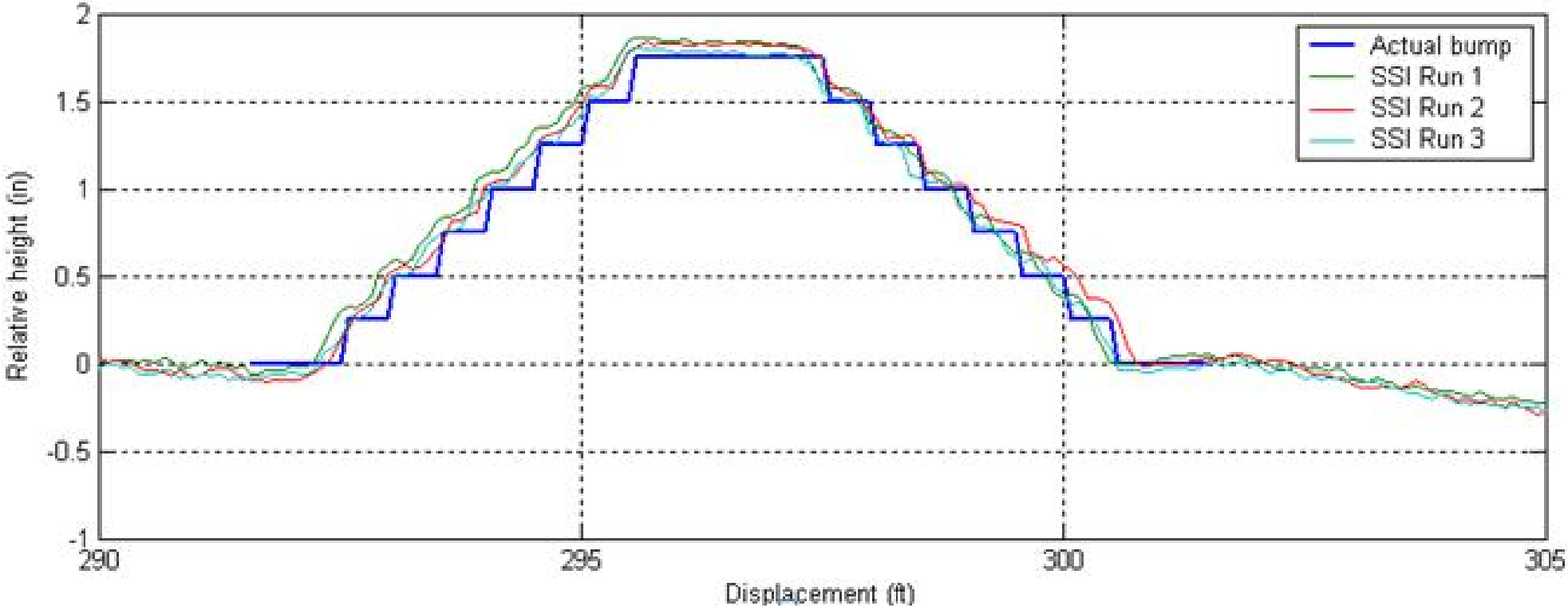

Figure 2: Actual Location and Dimensions of Artificial Bump as Detected by SSI Laser Profiling System

SSI acquired competing profiling systems and ran those systems over the artificial bumps and other test track surfaces using the manufacturer's recommended instructions for normal data collection and data analysis. Figures 3, 4 and 5 below show some examples of the results from competitor systems.

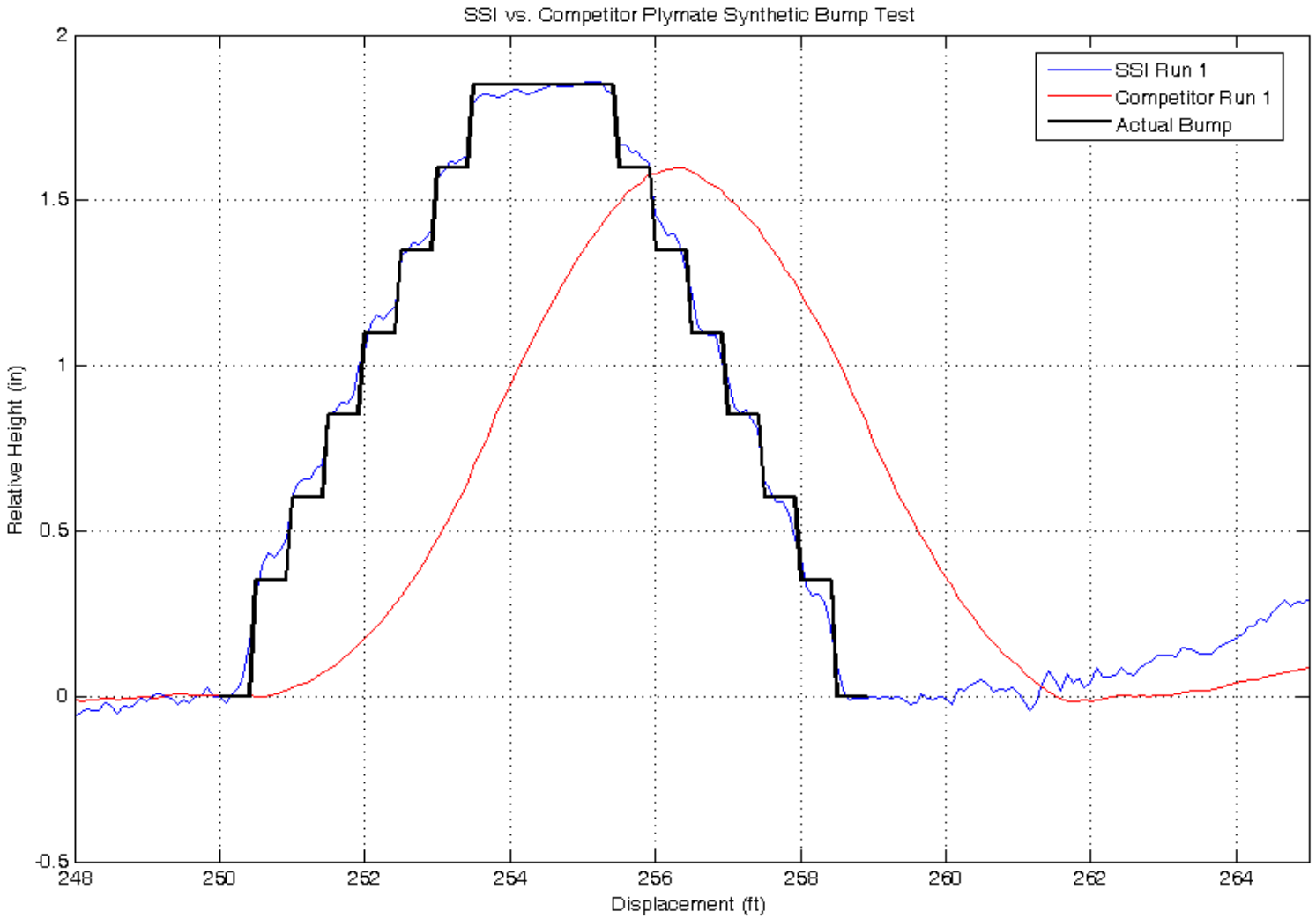

Figure 3: Actual Bump Height Dimensions Detected by Competitor 1 Laser Profiling System

Figure 3 shows the results of a competing system run across the artificial bumps. The black line is the actual bump, the, blue line is the data collected by SSI's system run across the bump at a random location, and the red line is a competitor's system run over the same bump. Note that the competitor system reproduces the bump with a flattened bell-curve shape, which can result when the raw profile data is excessively filtered. The two systems produce similar test results as mandated by DOT specifications (which both devices pass), but the SSI system does a superior job in

reproducing the true profile of the surface from the data collected by the profiling system. Figure 4 below shows the random artificial bump test comparison between the SSI profiling system and a second competitor's device.

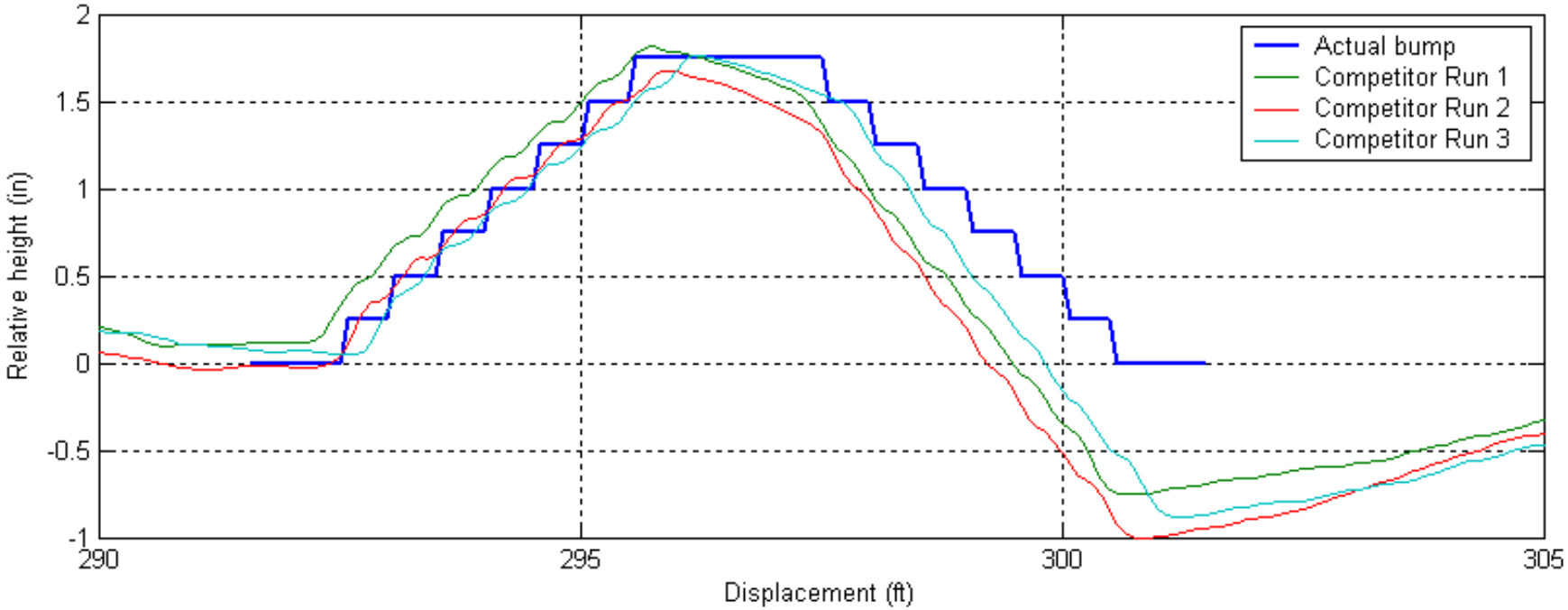

Figure 4: Actual Bump Height Dimensions Detected by Competitor 2 Laser Profiling System

Figure 4 shows the results of a second competing system run across the artificial bumps. Again, blue line represents the actual dimensions of the bump, with the "X" axis showing the longitudinal station of the bump (positioned from station 293 to 301), and the "Y" axis showing the height of the bump in .25" increments from 0 to 1.75 inches. The green, red and turquoise graphs depict the profile of the bump as reported by the competitor system over three consecutive data collection runs. As apparent from Figure 4, from the peak of the bump throughout the end of the defects, the height of the bump is misstated by as much as 1." The competitor system also demonstrates less repeatability than the SSI profiler, as is apparent from the gaps between each of the profile traces run over the same surface. While the differences between the competitor runs may appear as a relatively small 1-2 foot misplacement, on longer runs on rougher pavements, these errors could easily accumulate into a larger error.

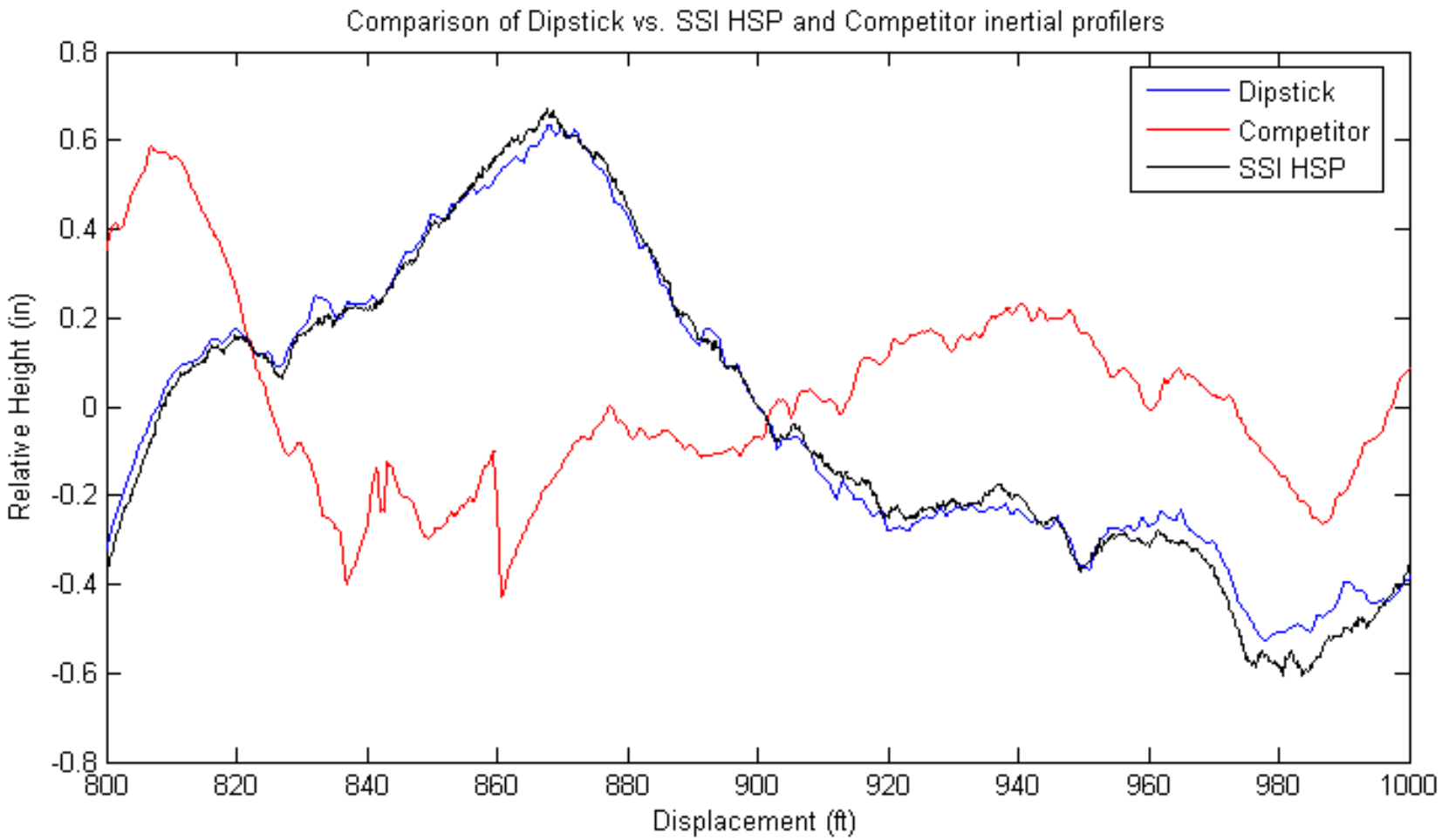

Figure 5: Error in Longitudinal Position of Surface Profile Events as Detected by Competitor Laser Profiling Systems

Figure 5 shows the results of an SSI system as compared to a Dipstick reference profile and the profile generated by a competing profiling system on a marked test surface. The blue line in Figure 5 represents the actual surface profile measured by a Dipstick static reference device used to generate independent reference profile data. The black line shows the profile measurements generated by SSI's profiling system run across the same surface. SSI's profile data matches nearly exactly the independent reference profile. The red line shows the profile of the same surface as generated by the competitor system. Notice how the peak of the actual bump located at station 865 is erroneously detected by the competitor system at station 810, representing a longitudinal positioning error of 55 feet, which SSI suspects is due at least in part to the filtering techniques used by the competitor device. SSI's profiling systems are unmatched in the industry for their ability to (1) match the actual surface profile as generated by independent reference devices, and (2) to detect the exact location and dimensions of localized roughness.