Harmonic Motion Test on the Acceleration and Deceleration of a Machine Tool

I What is the problem

As described in AP-1108, when contouring a circle, each axis goes through sinusoidal acceleration, velocity, and position changes, if the axis drives are not tuned properly contouring performance can be effected. Conventional interferometer systems can be used to check the acceleration and deceleration of a machine axis but they can only check straight-line moves.

II. How MCV-500 solves the problem.

The motion of each axis is a Harmonic motion. Since the acceleration is equal to the square of the feed rate divided by the radius of the circular path, the feed rate and the acceleration can determine the radius. Using 80% of the maximum feed rate and 80% of the maximum accelerations, the minimum radius can be calculated. Measuring the Harmonic motion of the minimum radius at 80% maximum feed rate, the maximum acceleration can be determined. Also, the deviations from a Harmonic motion can be used to determine the dynamic performance of the machine. For example, in Fig. A, the displacement, velocity and acceleration are all sinusoidal. This is an indication of good performance. However, in Fig. B, the displacement looks sinusoidal, but the velocity looks like triangular shape and the acceleration looks like square shape. This is an indication of poor performance, due to low acceleration or poor servo control.

III How it works

A unique property of the MCV-500 laser calibration system is the single aperture optical arrangement. Since both the outgoing laser beam and the return laser beam are using the same aperture, it is possible to use a flat-mirror as the target. By aligning the flat-mirror to be perpendicular to the laser beam, the mirror motion along the laser beam direction can be measured. The mirror motion perpendicular to the laser beam will not displace the laser beam, hence not effecting the alignment on the measurement. Therefore, the displacement, velocity and acceleration of a circular path along the beam direction can be measured.

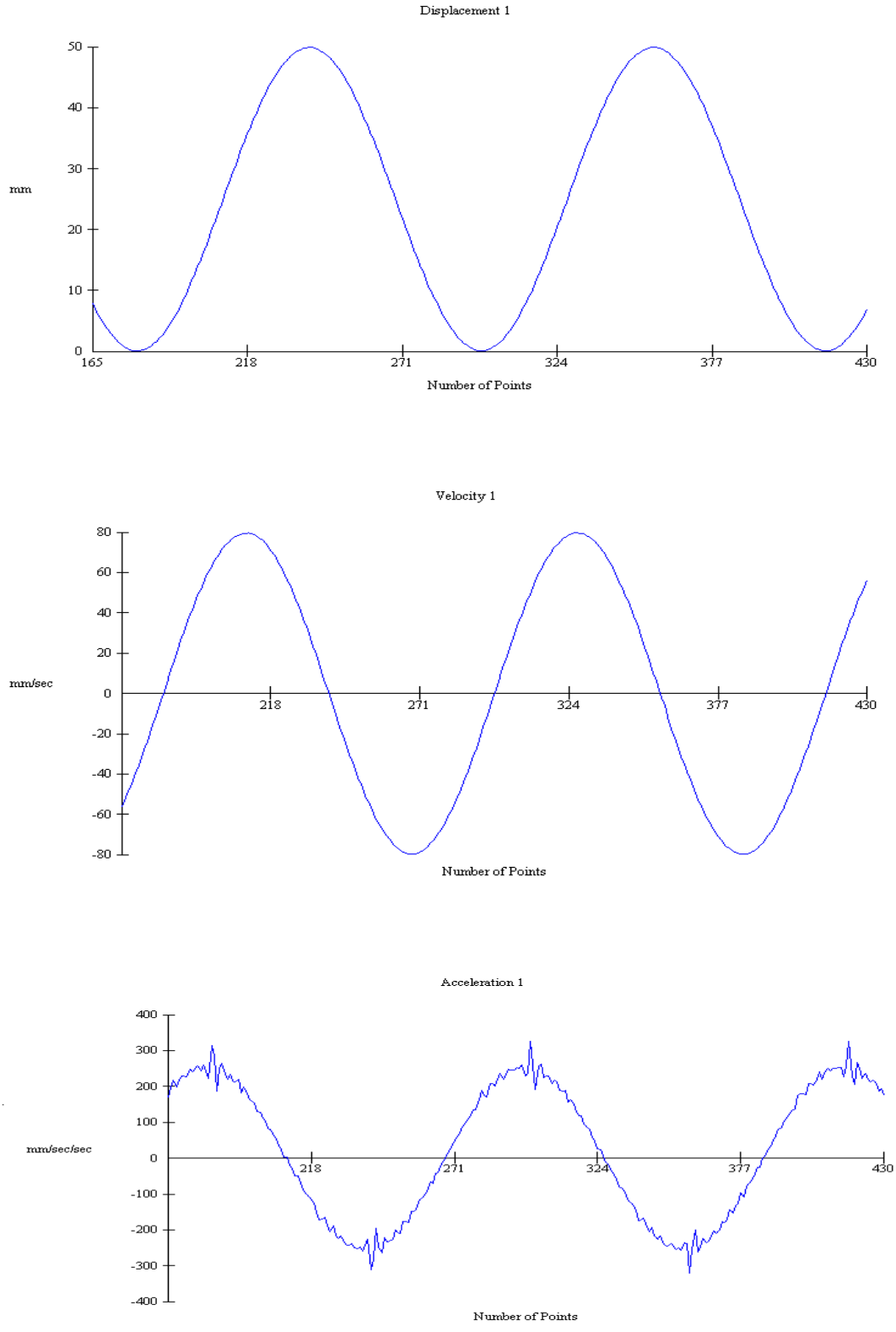

Fig. A Displacement, velocity, and acceleration close to a harmonic motion.

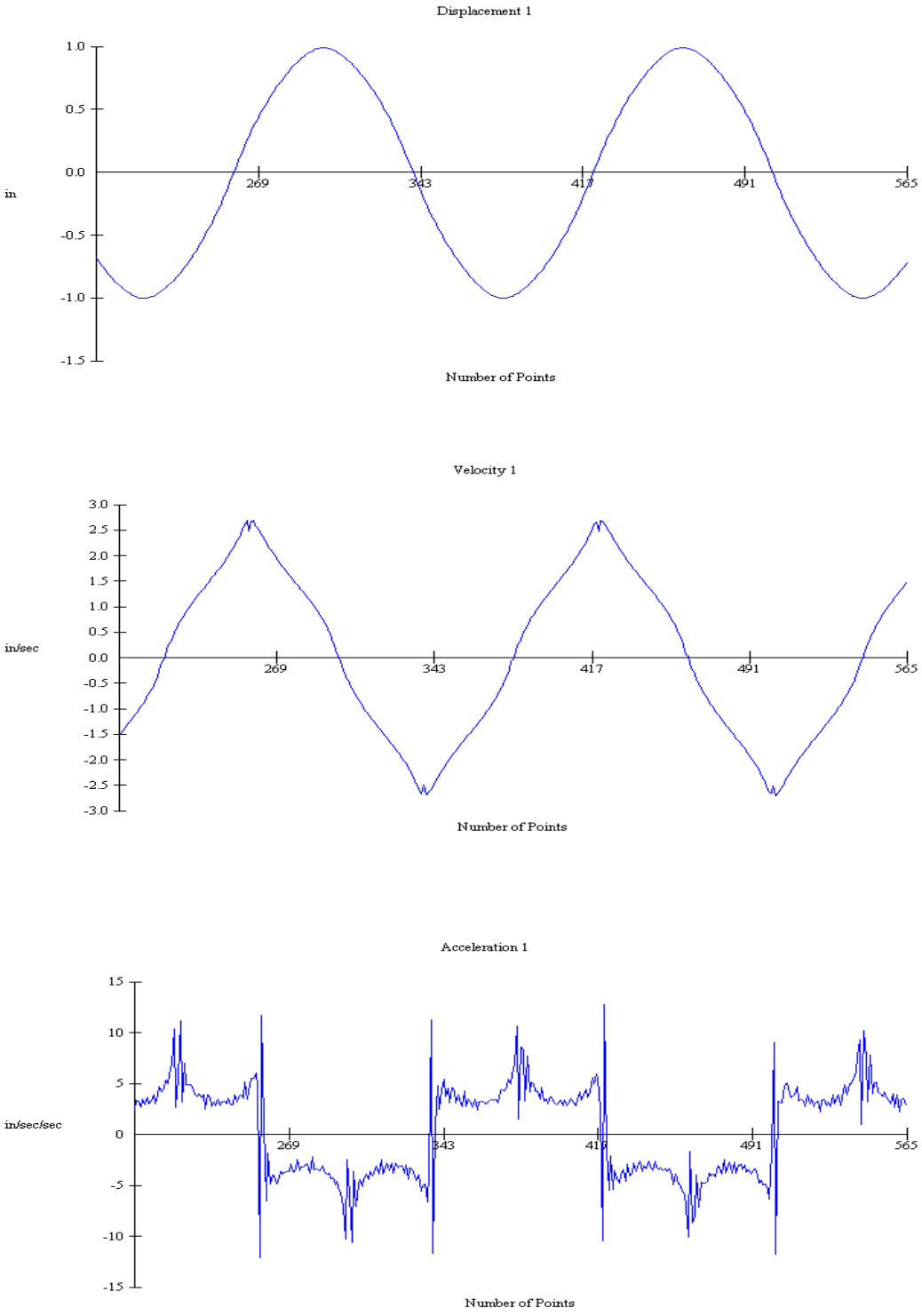

Fig. B Displacement, velocity, and acceleration deviated from a Harmonic motion.

IV Need more information
Call Optodyne at 310-635-7481 or
your local representative.