Alignment of Parallel Guideways

I, What is the problem?

For accurate machines, it is important that the guide ways are parallel. Non-parallel guide ways not only reduce the accuracy, also generate stress, play, stick/slip, and excessive wearing. An alignment laser with a quad-detector and a pentaprism (optical square) can be used to check the parallelism of two guide ways. However, in a shop environment, the air circulation (air turbulence) and temperature gradients will bend the laser beam and reduce the measurement accuracy.

II, How LDDM solves the problem.

The straightness measurement using an alignment laser is using the straightness of the laser beam as a reference. The laser beam is truly straight in vacuum. However, in a shop environment, because of the air circulation and temperature gradients, the laser beam will be distorted and reduce its straightness.

By definition, the parallelism of two guide ways is the variation of the distances between the two guide ways. If the distances are a constant, the two guide ways are truly parallel. Based on this principle, a dual-beam LDDM laser system can be used to measure the variation of distances between the two guide ways. The accuracy of the laser displacement measurement is 1 PPM. Hence the parallelism measurement can be very accurate.

III, How it works.

A unique property of the LDDM dual-beam laser system is that it can measure both linear displacement and angular displacement simultaneously. As compared to a typical laser interferometer, it can only measure linear displacement or angular displacement at two different settings.

First, mount the dual-beam laser head near one end of the two guide ways, a retroreflector on one slider and a retroreflector and a 90-degree beam bender on the other slider as shown in Fig. 1.

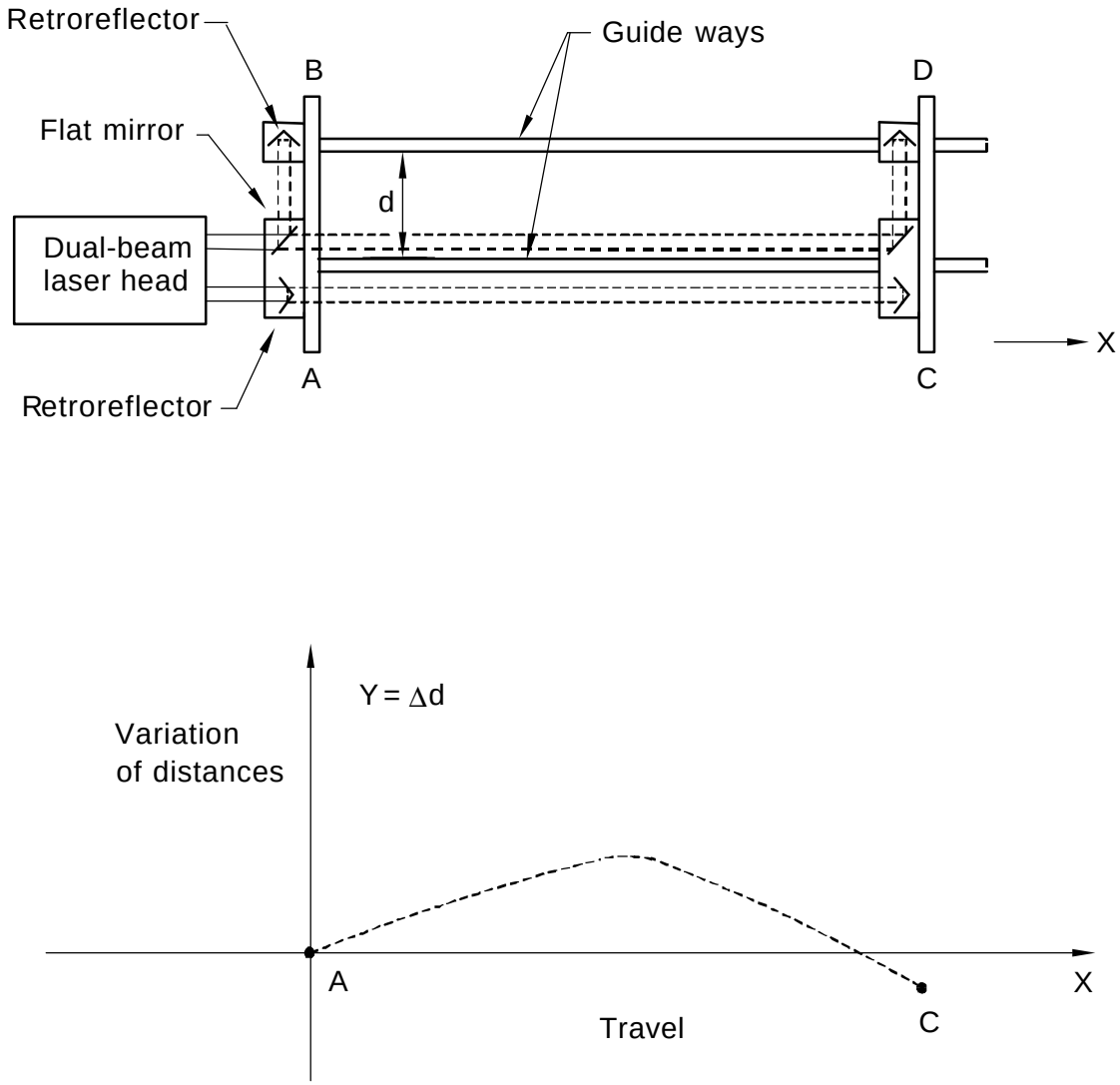

Fig. 1 Measurement of parallelism of two guide ways by a LDDM dual-beam laser system

A mechanical device that moves both sliders together is installed. Align the laser head, the 90-degree beam bender and the two retroreflectors such that the return beams enter the receiving apertures. Set up a notebook computer with Windows™ software; click on the Optodyne icon and the "straightness" button. The screen will show the linear displacement of one retroreflector and the change in displacement of the two retroreflectors. Set the beam separation value to 1 and check the on-the-fly data collection. Move the sliders to the initial position, reset the readings and click on the "start" button. Then move both sliders continuously from starting position to the end position. The linear positions and the variation of distances between the two guide ways will be measured and data stored. An example of the data plot is shown in Fig. 1. After adjusting the guide ways, the same procedure can be repeated until the required parallelism is reached.

Please note that the sliders are <u>not</u> required to move exactly the same amount along the x-direction. The distances between the two guide ways are always measured along the laser beam direction even if the retroreflector is moved away from the center of the laser beam. Hence high accuracy can be obtained without precise alignment and movement.

IV, Need more information.

Please call Optodyne at (310)-635-7481 or
Your Local Representative.