Motus Mechanical

Performance Datasheet

Folded Compound Linear Translation stage

The folded compound linear translation stage is a variant of the simple four-bar arcuate translation stage. It consists of two separate four-bar stages, one nested around the other. By producing an identical second stage, the arcuate motions can be nearly eliminated, thus enabling for an ultra-linear, smooth-continuous, flexure translation mechanism. This device provides 8 mm of motion which is limited only by the yield strength of the flexure springs. By using thinner, more compliant springs (or bidirectional movement), this range can be increased significantly.

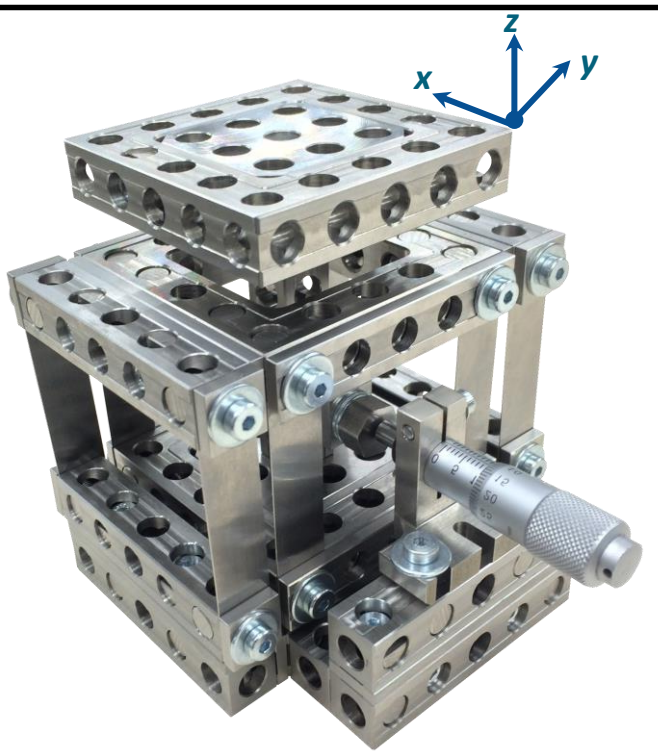

Figure 1: Folded compound flexure translation stage assembled using MechBlocks from Motus Mechanical.

Defining the x-axis as the primary direction of motion, as shown in Figure 1, the roll, pitch, yaw, straightness in y, and straightness in z were measured using an Optodyne LDDM laser interferometer and two DTM22 Lion Precision capacitance gages. These errors were also measured for two commercial precision motion stages; one with crossed roller bearings and one with ball bearings. Plots of the errors for each mechanism are shown in Figure 2 through Figure 6. In addition to plotting the errors, the standard deviation of the linear fit for each error is included in the plot legends to provide information on the linearity of translation errors.

The results in Figure 2 through Figure 6 show the folded compound linear translation stage displays larger pitch and roll errors, but comparable yaw, y-straightness, and z-straightness errors to the commercial precision crossed roller and ball bearing stages. For the angular deviations, the folded compound linear stage had errors with higher linearity. For the straightness deviations, the translation stage had errors that exhibited repeatable arcuate motions, not fully eliminated by the compensating arcuate stages. In contrast, the commercial crossed roller and ball bearing stages exhibited motions with no apparent systematic component that in practice can be difficult to predict or compensate.

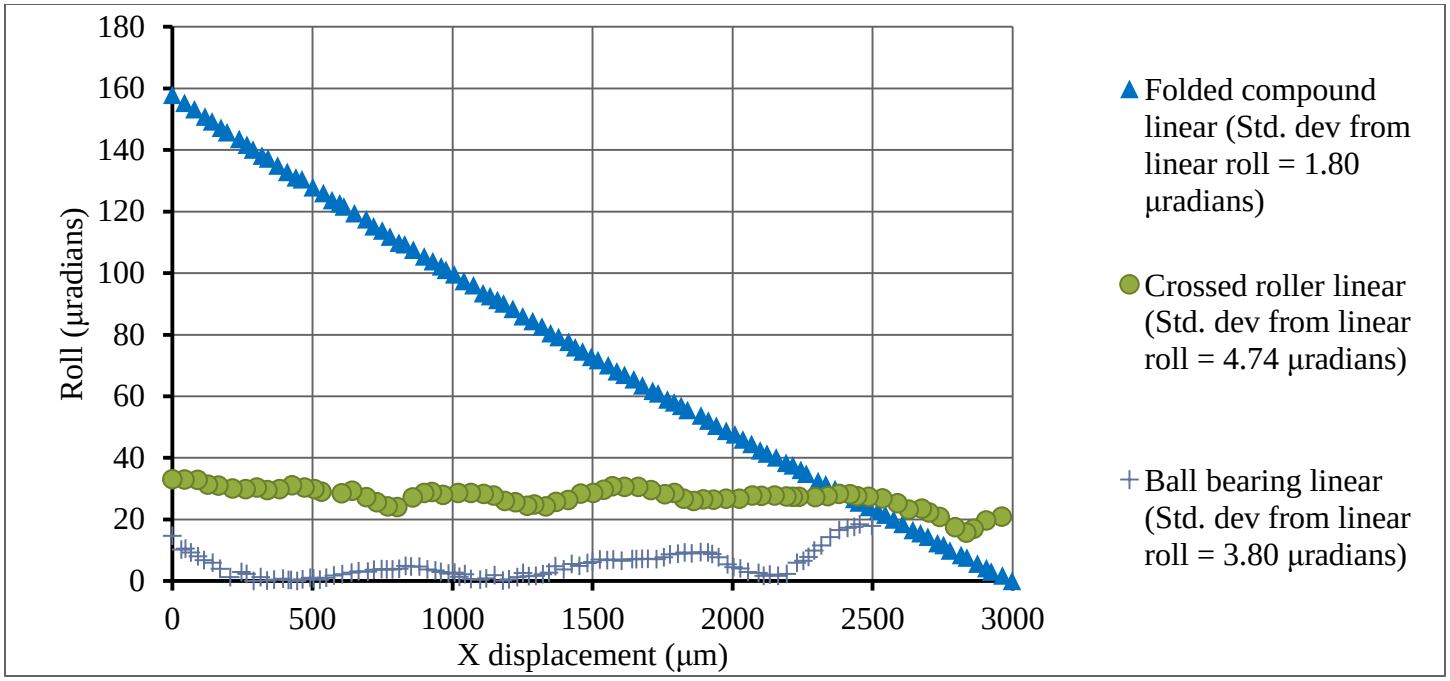

Figure 2: Plot of roll (rotation about the x-axis) for the three mechanisms. The folded compound linear translation stage has the largest total roll error, but this error had the highest linearity (lowest standard deviation).

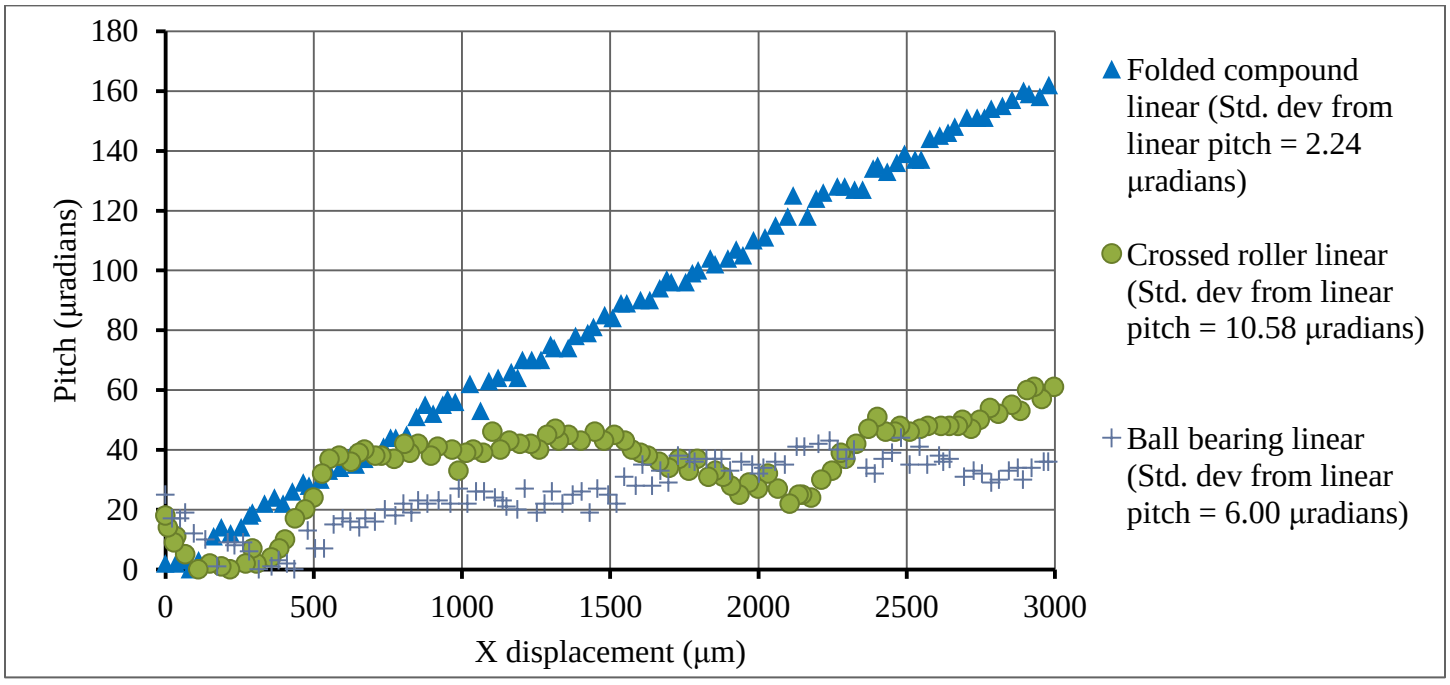

Figure 3: Plot of pitch (rotation about the y-axis) for the three mechanisms. The folded compound linear translation stage has the largest total pitch error, but this error had the highest linearity (lowest standard deviation).

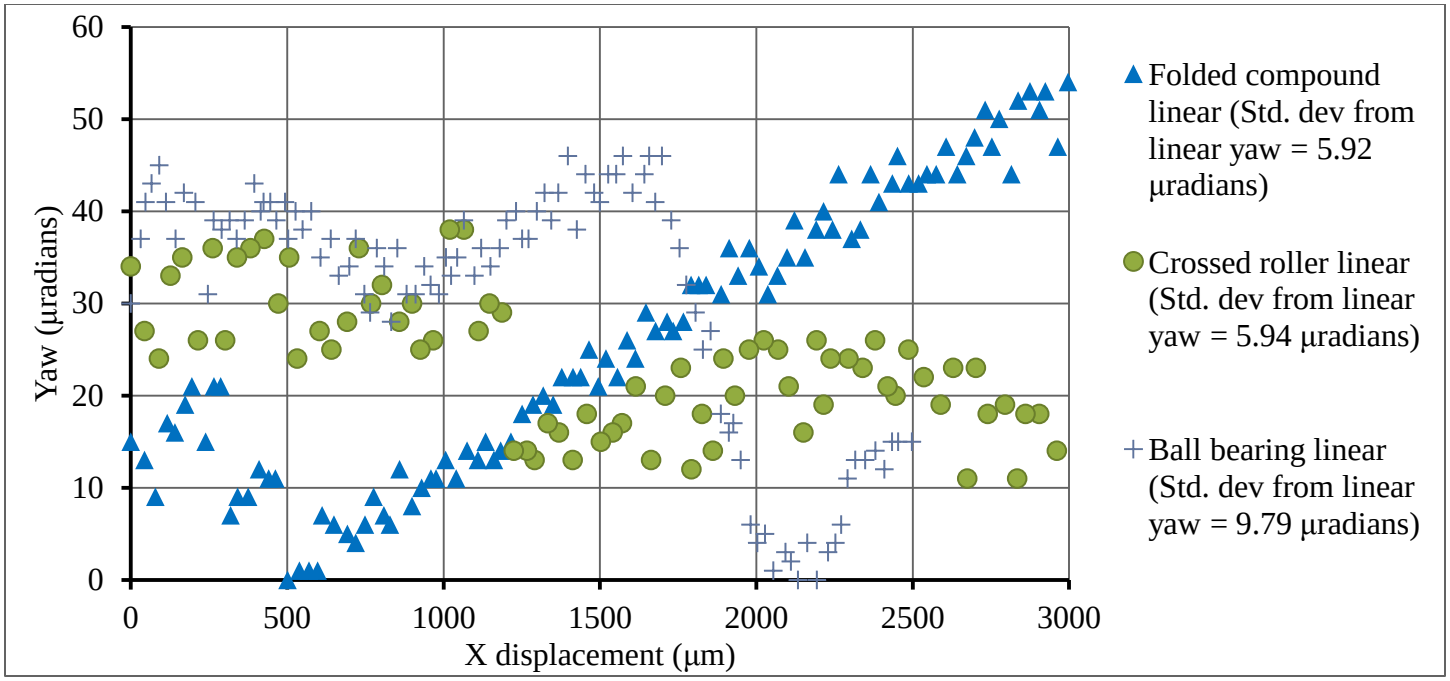

Figure 4: Plot of yaw (rotation about the z-axis) for the three mechanisms. The folded compound linear translation stage has a total yaw error and linearity comparable to the crossed roller and ball bearing stages.

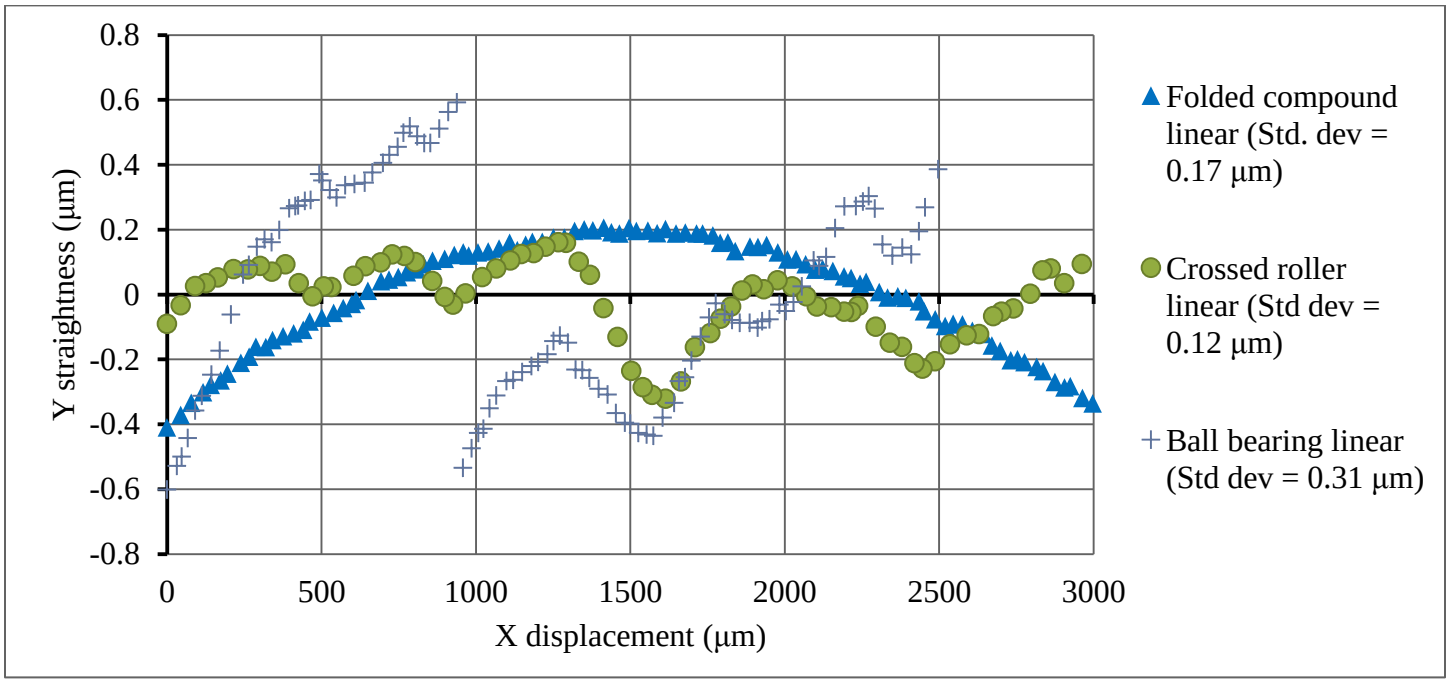

Figure 5: Plot of y-straightness (deviation in the y-axis) for the three mechanisms. All three mechanisms have comparable straightness errors and measured linearity. The folded compound linear translation stage features a repeatable, noise-free, arcuate motion.

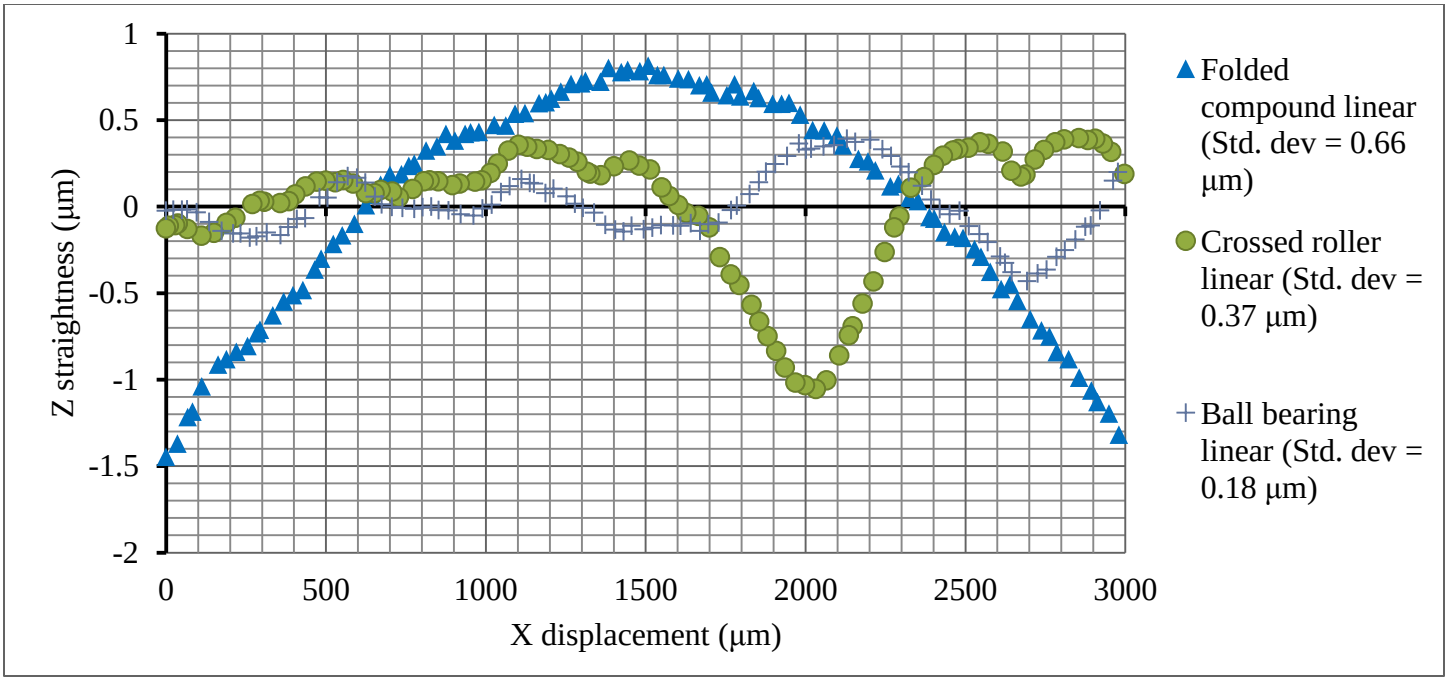

Figure 6: Plot of z-straightness (deviation in the z-axis) for the three mechanisms. All three mechanisms have comparable straightness errors and measured linearity. The folded compound linear translation stage features a repeatable, noise-free, arcuate motion.