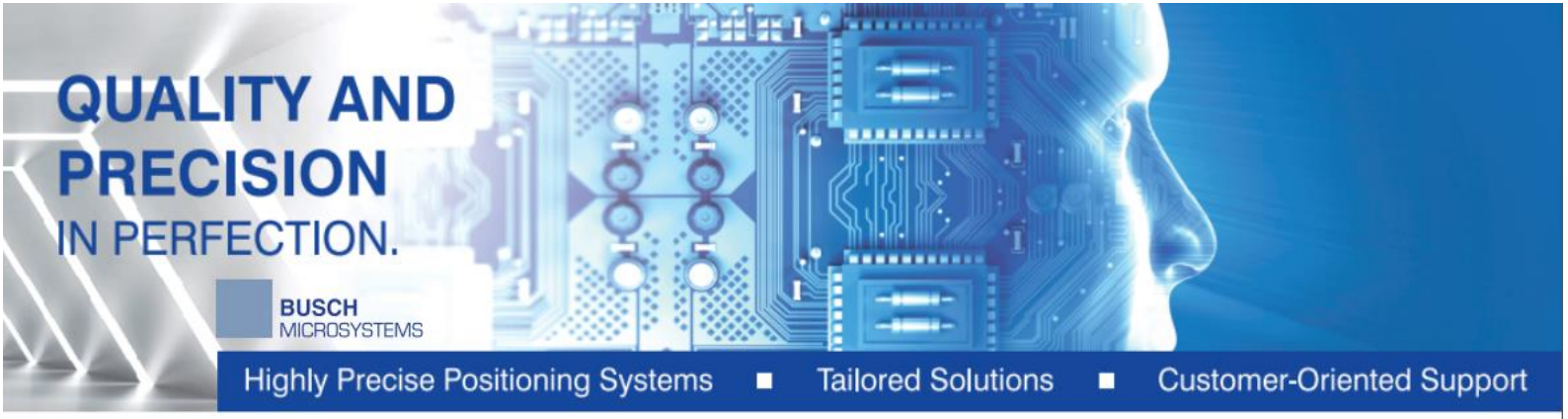


Dynamic error compensation using the example of a cross stage

April 3rd 2018, first edition, J. Offermans

1. Introduction

Despite maximum care during production and in the selection of components used, systematic errors can occur in a system. These can have a variety of causes, for example the accuracy of the encoder scale used, the straightness of the rails or the perpendicularity of the axes to each other.

As a rule, however, these errors are insignificant so that we can achieve the accuracy required by our customers. For particularly high requirements, the control offers the possibility of compensating for systematic errors and thus achieving the highest accuracy requirements.

In the following, this will be shown by means of dynamic error compensation.

2. Operating principle

The operating principle of dynamic error compensation is that a deviation is determined for each position in the working range. This deviation is taken into account when generating the target positions and a corresponding new target position is approached.

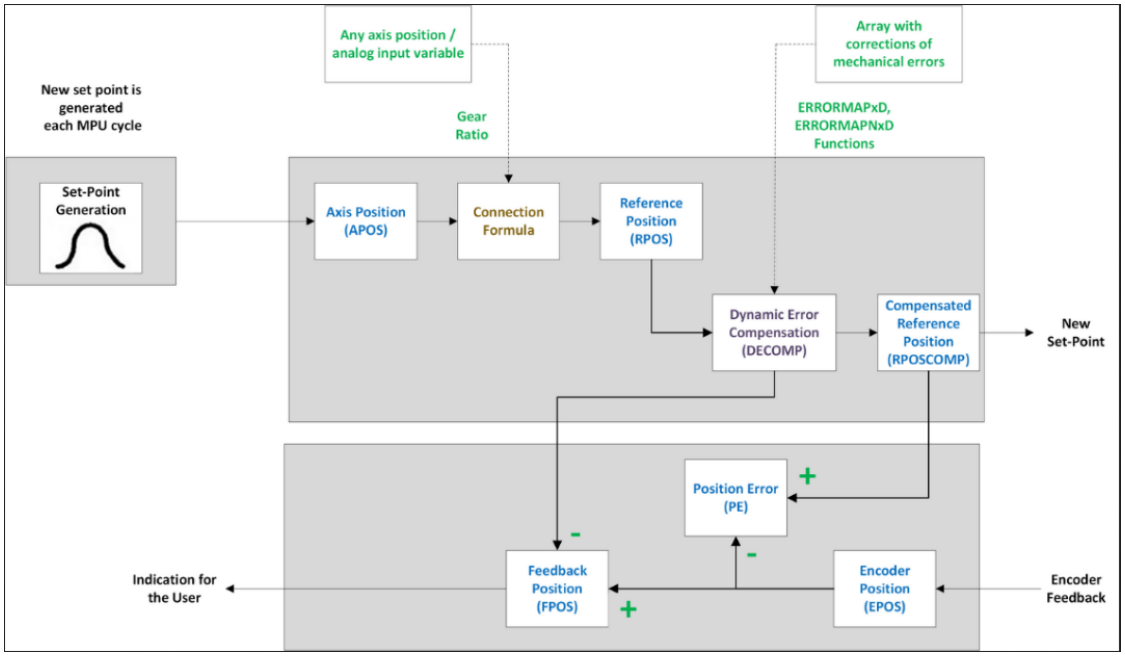
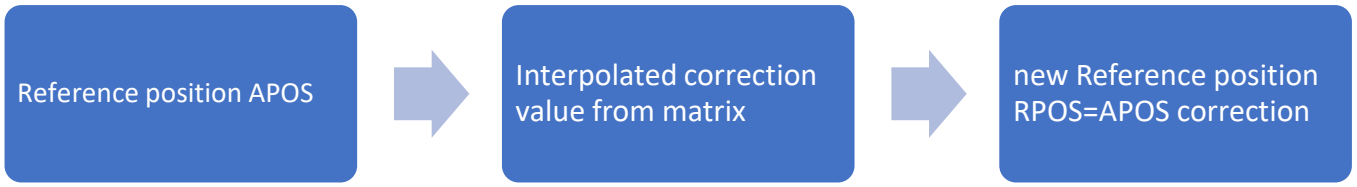


Figure: Operating principle of dynamic error compensation

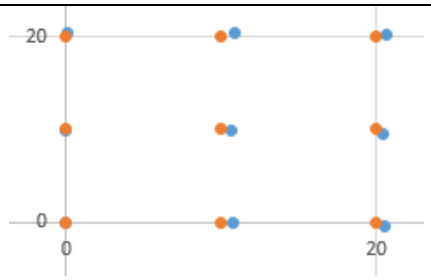
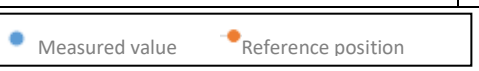
Within the motion controller, the following assumption usually applies:



To calculate the compensation value, a matrix or an array with the measured position deviations is created.
The position deviations are measured at fixed intervals.
The compensation value for the current position is interpolated between two known position deviations.
The compensation can be one-, two- or three-dimensional, whereby the effort required to determine the data increases with each dimension.

3. Compensation procedure

First the position accuracy in the initial state must be measured. For this purpose, a suitable measuring device must be used, which outputs the position deviations in all required directions and these in a CSV stage.
This stage is then converted with a tool developed by BUSCH Microsystems, which converts the deviations as a function of the dimension. These are now inserted into the motion controller.

Before compensation	After compensation
Accuracy: 3 µm	Accuracy: 0,3 µm
	
	deviations of the measured values increased by factor 1000

4. Conclusion

The accuracy is improved here by a factor of 10. The example shown here shows both the high precision that can be achieved by careful selection of components and assembly, and the hidden potential of dynamic error compensation.