Axis Compensation

Application Note 140

The *Axis Compensation* module allows to compensate systematical position deviations of an axis. The axis compensation can significantly improve the absolute accuracy of the machine.

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Document AN140_AxisCompensation_EP
Version 002, 2023-04-26
Source Q:\doc\ApplicationNotes\
Destination T:\doc\Org\Templates
Owner chm

1 Introduction

Usually the compensation data is based on calibration data, recorded with an external measurement system. This data has to be converted to the binary *TAM Table* format, to deploy it to the drive. On the drive side, the compensation is evaluated and applied by a *Tama* program. This *Tama* program is provided by *Triamec Motion AG* on request. Also the source code is available and allows to implement user specific solutions.

This document first describes the required steps to setup the axis compensation. Afterwards, some remarks about the implementation are provided.

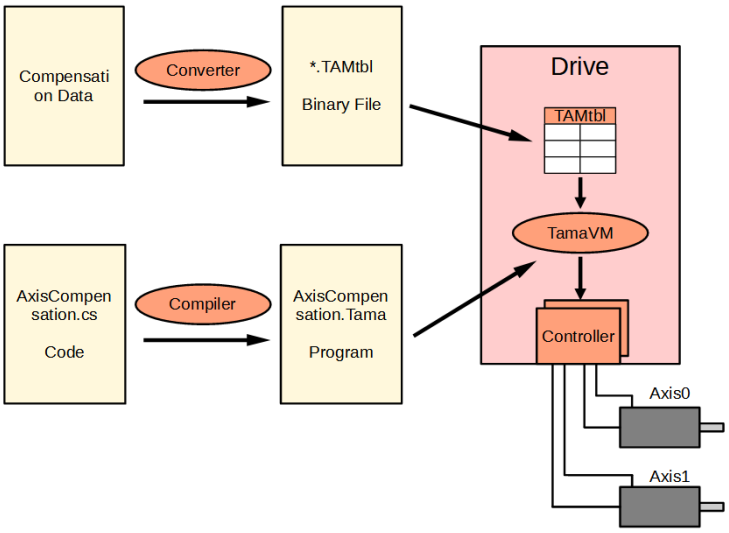

Figure 1: Overview of Setup with TAM Table and Tama program.

2 Setup the Axis Compensation

2.1 Transfer the Compensation Data

1. The compensation data need to be provided as a binary file in the *TAM Table* format. A detailed description of the table format can be found in [1]. Depending on the format of the calibration data, a converter has to be programmed. *Triamec* provides converters for some data formats. Please contact *Triamec Motion AG* for more information.

2. The transfer of the compensation data to the drive is done via the web server of the drive. See [1] for how to access the web server with a browser. The table can be transferred to one of the predefined **.TAMtbl* files listed on the **Directory** page (Figure 2). It is recommended to copy the desired path from the list into the clipboard.
   Change to the *transfer to drive* page and paste the file path to the **Filepath in drive** text box. Click **Browse...** to select the binary file containing the compensation data (Figure 3). Press Start to initiate the transfer.

3. In case the Persistent register in the table header is set to true, the table is stored permanently to the drive. Alternatively the table can be stored persistently by setting the following registers:
   Application.Tables.Small1.Header.Persistent = True
   Application.Tables.Small1.Command = Commit

Directory

File	actual size bytes	maximum size bytes
tables/small1.TAMtbl	304	65360
tables/small2.TAMtbl	0	65360
tables/small3.TAMtbl	0	65360
tables/small4.TAMtbl	0	65360
tables/small5.TAMtbl	0	65360
tables/small6.TAMtbl	0	65360
tables/small7.TAMtbl	0	65360
tables/small8.TAMtbl	0	65360
tables/large1.TAMtbl	0	2096976
tables/large2.TAMtbl	0	2096976

Figure 2: Directory page.

Transfer a file to the drive

Filepath in drive: tables/small1.TAMtbl
Select from PC: Browse... Table2dDemoX.TAMtbl
Start

Figure 3: File transfer page.

2.2 Load and Run the Tama Program

1. The source code of the *Tama program* `AxisCompensation.cs` can be requested from *Triamec Motion AG*.
2. The *Tama program* might be adjusted depending on the application. The following implementation needs to be verified and might be adjusted:
   a) For one or two dimensional compensation, uncomment the corresponding preprocessor directive `#define compensation1D` or `#define compensation2D`.
   b) The compensation is implemented for both Axis[0] and Axis[1]. If only one axis has to be compensated, the code for the other axis has to be commented out.
   c) In the sample code table *small1.TAMtbl* is used for the compensation of Axis[0] and *small2.TAMtbl* for the compensation of Axis[1]. This needs to be adjusted according to the table the compensation data was transferred to.
   d) For one dimensional compensation the setpoint position of Axis[0] is used as the variable for the interpolation. For the two dimensional interpolation the setpoint for Axis[0] is used as the first variable and the setpoint of Axis[1] as the second variable for the bilinear interpolation.
   e) The interpolated compensation value is applied to Commands.PositionController.Encoders[].InjectedPosition, which is then added to the encoder value by the firmware.
   f) The compensation is activated as soon as Homing.State = HomingDone and the axis is enabled.
3. We recommend Visual Studio to build the *Tama* program.
4. See [2] on how to download the *Tama* program, enable the *isochronous TamaVM* and save it persistent on the drive.

3 Implementational Considerations

3.1 Compensation Sign

It is assumed that the value of the axis compensation Δx provided as the difference between the external reference position x_{Ref} and the encoder position x_{Enc}.

$$\Delta x = x_{Ref} - x_{Enc} \tag{1}$$

Therefore in the *Tama* program the evaluated axis compensation Δx is added to the current encoder position x_{Enc} program to reconstruct the reference position x_{Ref}.

3.2 Switch on of the Compensation

Initially, the connection of the compensation is smoothed via a ramp to avoid a jump. The duration of the ramp is defined by the constant `cRampTime`.

3.3 Interpolation Type

For the compensation within the set-points linear interpolation is used for one dimensional interpolation and bilinear interpolation for two dimensional interpolation.

The linear interpolation has the effect, that the velocity and its derivatives are discontinuous. This discontinuity can affect the surface at the location of the setpoint in some cases. If such an effect is detected, may an extension of the interpolator to a higher order may improve the situation, e.g. Qubic-B-Splines.

References

[1] “Triamec Drive File System”, AN124_Filesystem_EP003.pdf, Triamec Motion AG, 2023

[2] “Servo Drive Setup Guide, TSD and TSP Series”, ServoDrive-SetupGuide_EP020.pdf, Triamec Motion AG, 2023

Revision History

Version	Date	Editor	Comment
001	2021-09-14	dg	How to setup axis compensation
002	2023-04-26	dg, sm	General update, doc template, adapt to updated Tama program

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