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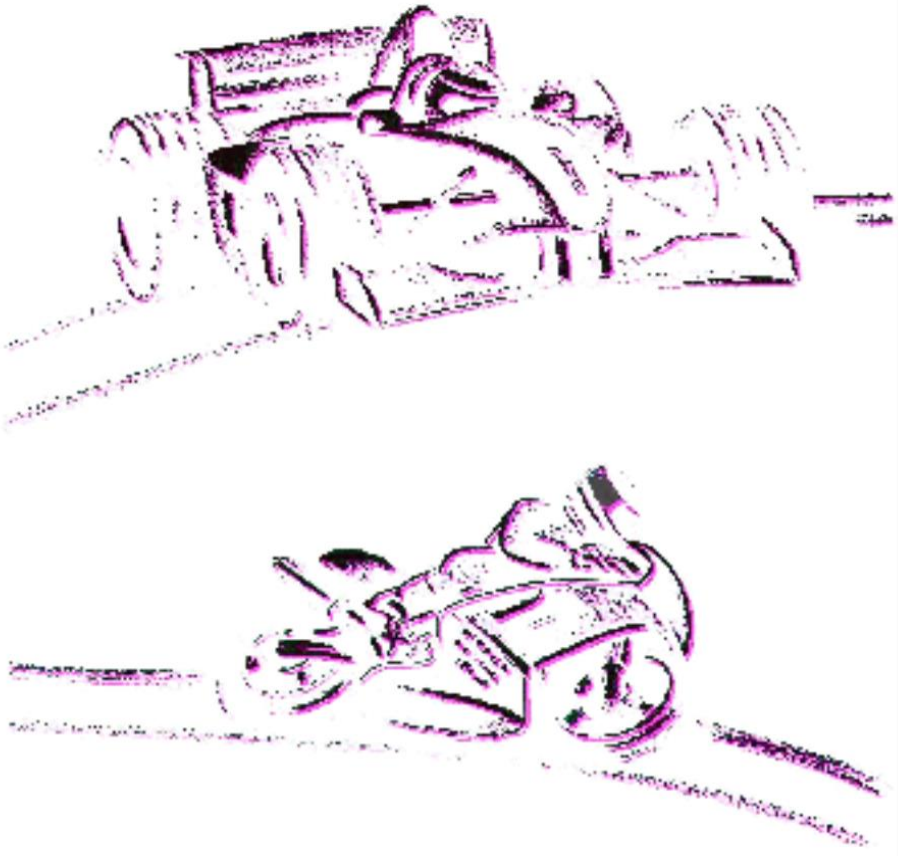
- English -



2D_FilterAndRotate

Setting manual

1 Revision History

Revision	Description	Release Date	Author
0	Initial Release	2022-01-11	FS

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3 Notes and symbols used in this manual

- In the paragraphs highlighted with this symbol, you will find tips and practical advice to work with the 2D-Software.

- Documentation reference to another manual

- In the paragraphs highlighted with this symbol, you will find additional information. It is very important that you follow the instructions given.

4 Preface

4.1 Software

When the *2D_FilterAndRotate* toolchain is used for the first time, it must be ensured that the software is updated to the latest version.

- 2D_FilterAndRotate is available only since **Race2022**
- To check for new updates:
  WinARace → Help → Search for software updates

4.2 Sensor recordings

Before using the toolchain, it must be ensured that setting and recording of the accelerometer and gyroscope channels are done correctly.

- For more information about setting and recording the accelerometer and gyroscope channels please see the manual **XXX** which can be found at the download area of our website:
  https://2d-datarecording.com/en/downloads/manuals/

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5 Introduction

The purpose of the *2D_FilterAndRotate* toolchain is to prepare the already recorded accelerometer and gyroscope channels for the later uses in the 2D Datarecording toolchains in post-processing.

- *2D_FilterAndRotate* toolchain is also able to process more than one sensor at a time.
- *2D_FilterAndRotate* toolchain can be used for 2D as well as other accelerometer and gyroscope channels.
- *2D_FilterAndRotate* toolchain can be used for recorded accelerometer and gyroscope channels as well as only for recorded accelerometer channels.

The preparation of accelerometer and gyroscope channels contains:

- Rotational correction
- Filtering

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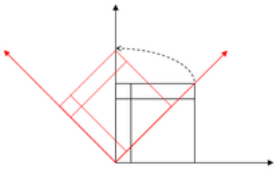
6 Descriptions

6.1 Rotational correction

In this step, the basic mounting position (**Rotation**) as well as fine corrections of the mounting position (**Correction**) of the respective sensor can be corrected subsequently in post-processing via *CalcTool* and *SpecSheet*.

Rotation	Correction
Adjustment of the basic installation position	Fine adjustment of the basic installation position
Examples:	
Due to the conditions on the vehicle, the sensor must be mounted at an angle of 45° around y-axis. 	Due to the decreasing adhesive force of the adhesive tape, the sensor slipped during a braking test, which is why the angle of the sensor must be corrected by 2° in the x-axis for a measurement.

- A rotation or correction around one axis affects that only the values of the other two axes are changing. This behaviour is correct!

- If also gyroscope channels of specified sensor exist, also the respective gyroscope channels are to be rotated too!

6.2 Filtering

In this step, the recorded accelerometer and if available also the gyroscope signals can be processed for further use in the toolchain by filtering.

For filtering an *Infinite impulse response* (IIR) filter which does not apply any time delay to the filtered data. Also, the output frequency of the filtered channels can be set here (chapter 9.4).

6.3 Further information

This toolchain can be executed in four different ways, which differ in whether the channels are basically only filtered or only rotated, or both together, one after another (chapter 9). Technically there is no difference if first Filter and then Rotate or vice versa.

It is also possible to process multiple sensors in this toolchain (chapter 9).

The created channels, no matter which version of the toolchain is executed, the name extension of the output channels can be set (chapter 9.5).

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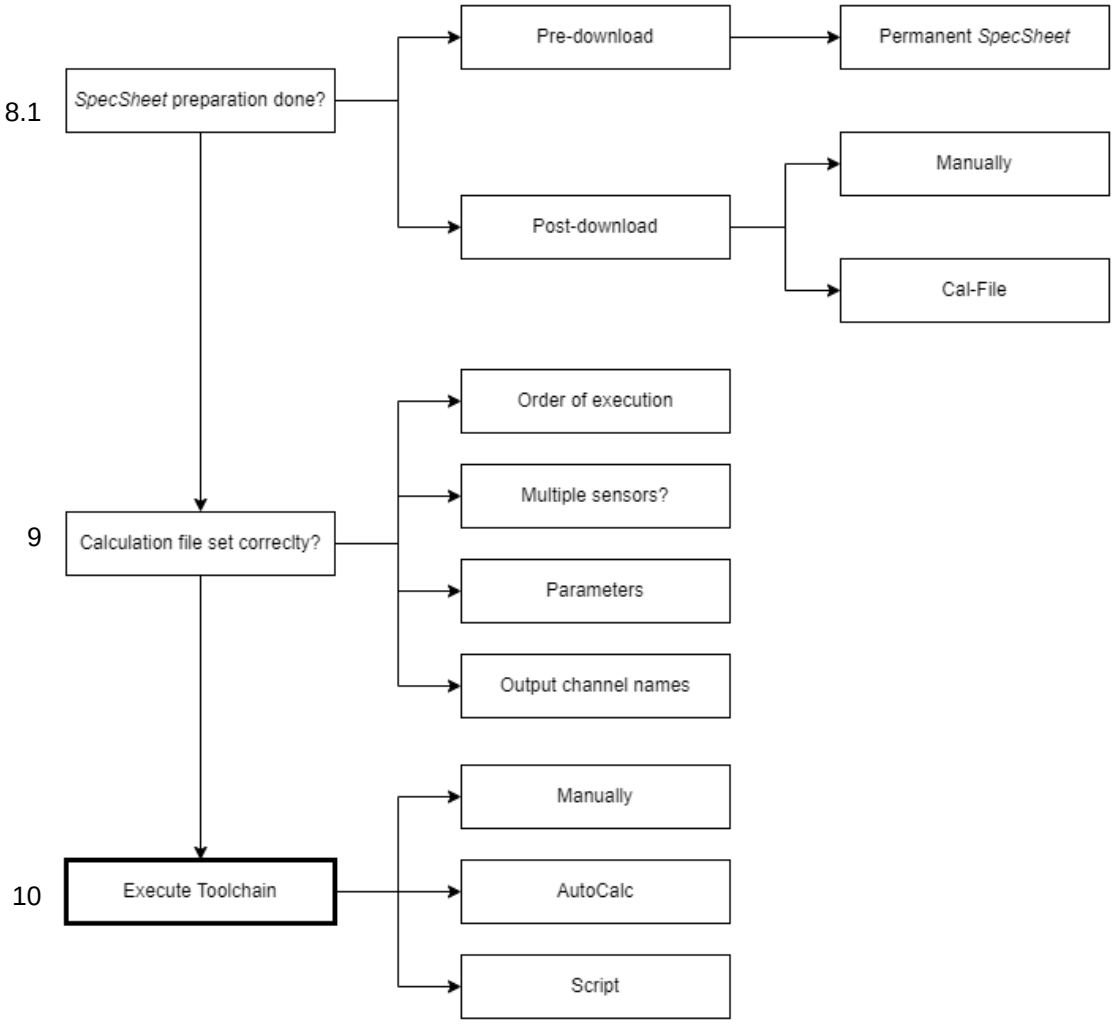
7 CHECKLIST



- If the toolchain was prepared for a use case (most of the times an event), only the last step *Execute Toolchain* must be carried out!

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8 Prepare toolchain

8.1 Prepare SpecSheet

The *SpecSheet* must be prepared either before **or** after downloading the measurement.

The *SpecSheet* entries in the following table are necessary for the calculation of the *2D_FilterAndRotate* toolchain:

Group	Entry	Value	Description	Chapter
Sensor_**X**	Rot_ x	*(0) USER*	Rotational correction of the respective sensor	6.1
	Rot_ y	*(0) USER*		
	Rot_ z	*(0) USER*		
	Cor_ x	*(0) USER*		
	Cor_ y	*(0) USER*		
	Cor_ z	*(0) USER*		

- For each sensor, the toolchain will be executed, an own Sensor_**X**-group must be created!

  Example:

  Extension: _Rot → SpecSheet group: Sensor_Rot.Rot_x

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8.1.1 Pre-download

At every download of a measurement, whether from stick or directly from a logger, the <*DataDir*> directory is check for a so called permanent *SpecSheet* with the name of the logger the data was recorded with.

This permanent *SpecSheet,* with a link to the logger name, will be automatically copied to the respective measurement directory at measurement download and be renamed with the same name as the measurement.

Therefore, it is possible to prepare the respective permanent SpecSheet so that the *2D_FilterAndRotate*-relevant data is entered there.

- For more information about *SpecSheet* and permanent *SpecSheet* please visit the download area of our website and have a look at the manual *SpecView*.
  https://2d-datarecording.com/en/downloads/manuals/

8.1.2 Post-download

8.1.2.1 Manually

One possibility to prepare the *SpecSheet* is to manually prepare the *SpecSheets* via an *Editor.*

- This step is very time-consuming and would have to be repeated for each newly downloaded measurement.

8.1.2.2 CalcTool

To automate the preparation of the *SpecSheet*, the respective entries can also be entered via *CalcTool* by creating a calculation file.

- For an example, please see chapter 11.1

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8.2 Prepare channels

For the correct functionality of the *2D_FilterAndRotate* toolchain, the **input** channels must correspond to the following name convention:

Channel type	Axis	Extension
Acc	_x	_11

Examples:			
	x-Axis	**y-Axis**	**z-Axis**
Sensor_1	Acc_x_1	Acc_y_1	Acc_z_1
	Gyro_x_1	Gyro_y_1	Gyro_z_1
Sensor_11	Acc_x_11	Acc_y_11	Acc_z_11
	Gyro_x_11	Gyro_y_11	Gyro_z_11
Sensor_Rot	Acc_x_Rot	Acc_y_Rot	Acc_z_Rot

- Always an extension is required for executing the toolchain!
- This naming convention is usually already observed automatically via WinIt when the logger settings are created. this means that the user only must assign the sensor numbers as desired when creating the setting.
- For each sensor, the toolchain will be executed, an own SpecSheet group Sensor_**X**- must be created (see chapter 8.1)! The X is replaced by the **Extension**.
  Example:
  Extension: _Rot → SpecSheet group: Sensor_Rot.Rot_x

- For more information about *WinIt* please visit the download area of our website and have a look at the manual *WinIt*.
  https://2d-datarecording.com/en/downloads/manuals/

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9 2D_3ax_FilterAndRotate.CAL

9.1 Copy 2D_FilterAndRotate.CAL

Copy ***2D_3ax_FilterAndRotate.CAL*** from ***<UserDataDir>\CalFiles\2DCalFiles*** in respective ***<EventDir>***.

The calculation file in ***<UserDataDir>\CalFiles\2DCalFiles*** should serve as an example.

- <UserDataDir>: Open *WinARace* → [CTRL] + [ALT]+[U]
- <EventDir>: Open *WinARace* → [CTRL] + [ALT]+[E]

9.2 Order of execution

This calculation file can be seen as main-calculation file because it contains the calls to start the *2D_FilterAndRotate* toolchain and specifies for which sensor the toolchain is to be executed.

Basically, the *2D_3ax_FilterAndRotate.CAL* only contains the following calls which are defining for which sensor the toolchain should be executed.

- Only Filtering
- Only Rotational correction
- First Filtering then Rotational correction

```
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_Filter         , p( _Rot, FilterSettings.FilterFreq, FilterSettings.ResampleFreq, _R)}
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_Rotate         , p( _Rot                                                        , _R)}
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_FilterAndRotate, p( _Rot, FilterSettings.FilterFreq, FilterSettings.ResampleFreq, _R)}
```

- In this example the toolchain is executed for Sensor Rot with Filter parameters from SpecSheet. Instead of SpecSheet parameters, also numbers can be used directly.
- Technically there is no difference if first Filter and then Rotate or vice versa. Thereby the combination RotateAndFilter is obsolete.

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9.3 Multiple Sensors

If the toolchain must be used for **multiple sensors**, the respective order of execution file must be called multiple times in a desired calculation file (*2D_3ax_Rotate.CAL*).

Example: Sensors 1, 11 and Rot should be only rotated:

2D_3ax_Rotate.CAL:

```
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_Rotate        , p( _1   , _R)}
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_Rotate        , p( _11  , _R)}
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_Rotate        , p( _Rot , _R)}
```

- There is no limit to the number of sensors for which the toolchain should be executed

- For each rotation of a sensor an own Sensor_**X**-*SpecSheet*-group must be existing (see chapter 8.1)!

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9.4 Filtering

For filtering an *Infinite impulse response* (IIR) filter which does not apply any time delay to the filtered data. Also, the output frequency of the filtered channels can be set here.

FilterFrequency: In this example FilterFrequency is set by SpecSheet value

OutputFrequency: In this example OutputFrequency is set by SpecSheet value

```
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_Filter         , p( _Rot, FilterSettings.FilterFreq, FilterSettings.ResampleFreq, _R)}
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_Rotate         , p( _Rot                                                        , _R)}
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_FilterAndRotate, p( _Rot, FilterSettings.FilterFreq, FilterSettings.ResampleFreq, _R)}
```

- In this example the toolchain is executed for Sensor Rot with Filter parameters from SpecSheet. Instead of SpecSheet parameters, also numbers can be used directly.

Group	Entry	Value	Description
FilterSettings	FilterFreq	*100 (USER)*	Definition of filter frequency
	ReSampleFreq	*200 (USER)*	Definition of frequency of the channels created by *2D_FilterAndRotate* toolchain

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9.5 Output channels

In order to prepare the output channels for other toolchains prepared by 2D, the **output channel names** of *2D_FilterAndRotate* toolchain can be set individually. Thereby same sensors raw channels can be used in toolchain e.g., with different filter frequencies.

If, for example, the toolchain is called up for Sensor Rot with the following call, the following output channels are obtained:

```
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_FilterAndRotate, p( _Rot, FilterSettings.FilterFreq, FilterSettings.ResampleFreq, _R)}
```

Input-channel name	Output-channel name
Acc_x_Rot	Acc_x_Rot_R
Acc_y_Rot	Acc_y_Rot_R
Acc_z_Rot	Acc_z_Rot_R
Gyro_x_Rot	Gyro_x_Rot_R
Gyro_y_Rot	Gyro_y_Rot_R
Gyro_z_Rot	Gyro_z_Rot_R

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9.6 Example

By using different **output channel names**, new channels with different **filter frequencies** can be created from **one raw sensor** channels:

```
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_Filter , p( _Rot, 100 , 200 , _F1)}
{$I <UserDataDir>\CalFiles\2DCalFiles\_2D_3ax_Filter , p( _Rot, 50 , 200 , _F2)}
```

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10 Execute toolchain

Open *Calculation File Manager* in *Analyzer* via tab *Functions* and select the *2D_3ax_FilterAndRotate.CAL* file.

- By clicking on *Execute*, the selected file will be executed

Also, the *2D_FilterAndRotate* toolchain can be executed automatically at every downloaded.

To do this, the *2D_3ax_FilterAndRotate* file must be included in the so-called *AutoCalc Configurator*.

- For more information about the *AutoCalc Configurator* please visit the download area of our website and have a look at the *CalcTool* manual.
  https://2d-datarecording.com/en/downloads/manuals/

The 2D_FilterAndRotate toolchain can also be inserted into a Script in which a freely combinable sequence of operations (e.g. CAL files, exports, templates, ...) is executed.

- For more information about the *Scripts* please visit the download area of our website and have a look at the *Export and Scripts* manual.
  https://2d-datarecording.com/en/downloads/manuals/

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11 Appendix

11.1 Prep_Spec.CAL

Prep_Spec.CAL

```
[PrepSpec_Sensor_1]
IfNotSpecValueExists(Sensor_1.Rot_x)
c1              = Const(0, 1)
Sensor_1.Name   = LastValue(#C1, 1)
Sensor_1.Rot_x = LastValue(#C1, 1)
Sensor_1.Rot_y = LastValue(#C1, 1)
Sensor_1.Rot_z = LastValue(#C1, 1)
Sensor_1.Cor_x = LastValue(#C1, 1)
Sensor_1.Cor_y = LastValue(#C1, 1)
Sensor_1.Cor_z = LastValue(#C1, 1)
```

The line ***IfNotSpecValueExists*** effects, that the respective group is only executed if the *SpecSheet* entry *Sensor_1.Rot_x* is **not** already existing.

- By using this line, an already existing entry is not overwritten!

These other lines are effecting, that the *SpecSheet* entries for Sensor_1 are all created with value 0 from Const-function.

- The Prep_Spec calculation file can be extended as desired.

- For more information about *CalcTool functions* please visit the download area of our website and have a look at the *CalcTool* manual.
  https://2d-datarecording.com/en/downloads/manuals/

11.2 Following Toolchains

Toolchains always consist of one or more calculation files and are used in postprocessing to realise various functions.

Many toolchains can be combined in a meaningful way to create a complex evaluation functionality.

- For more information about *Toolchains* please visit the download area of our website and have a look at the chapter *Toolchains in CalcTool* manual.
  https://2d-datarecording.com/en/downloads/manuals/

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