LGF_DifferenceQuotientFB/LGF_DifferenceQuotientFC

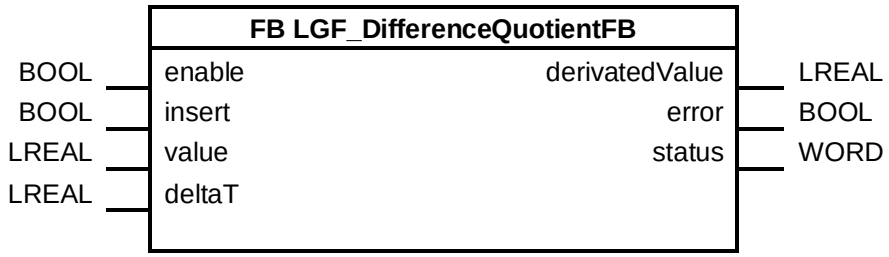
Short description

This block numerically differentiates a signal sampled equidistantly in time. For example, the velocity can be calculated from a measured locus curve, or the acceleration can be calculated from the measured velocity. In order to minimize the effects of a scattering measurement signal, this algorithm uses a compensating polynomial.

The block is implemented as a function and as a function block.

Function (FC)	Function block (FB)
The function calculates the differentiated values acyclically. The function reads an array that is differentiated. N-4 smoothed measured values can be calculated from N measured values. The output array contains the value 0 in the index (0,1,N-1,N). However, replacement values can be calculated.	The function block calculates the differentiated values cyclically. The function block reads-in a value with each positive edge on the “insert” input. As soon as five values have been read in, the block calculates a differentiated value and outputs it.

Function block (FB)



Input parameters

Parameters	Data type	Description
enable	BOOL	Activates the block. As long as enable is “TRUE”, the block can accept values on the parameter “value”.
insert	BOOL	Accepts the value at the “value” input and outputs a “derivatedValue” if five values have been read in.
value	LREAL	Value that must be included in the differentiation.
deltaT	LREAL	equidistant distance between two measured values. (e.g. 1s)

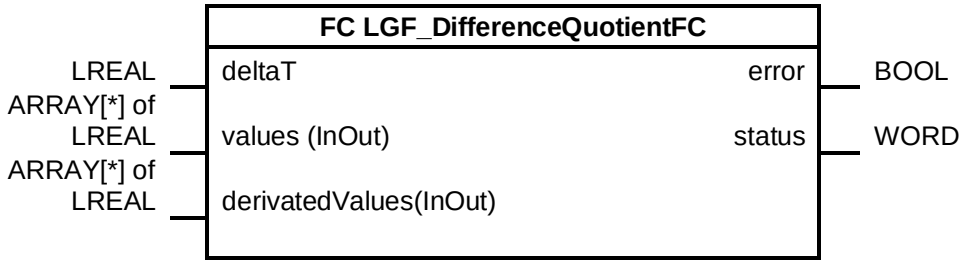
Output parameters

Parameters	Data type	Description
derivatedValue	LREAL	Differentiated value.
error	BOOL	FALSE: No error TRUE: An error occurred during the execution of the FB.
status	WORD	16#0000-16#7FFF: Status of the FB, 16#8000-16#FFFF: Error identification (see following Table).

Status and error displays

status	Meaning	Remedy / notes
16#0000	No error	Processing was completed successfully
16 #7000	Block is not being edited	The block waits for activation through the parameter “enable”.
16#7001	First FB call.	-
16#7002	Processing is active.	Subsequent call of the FB
16#7010	Too few values	The block requires five values to calculate a differentiated value. Transfer additional values with a positive edge on the “insert” input.
10#8200	Error: “deltaT” = 0	“deltaT” can’t be 0.

Function (FC)



Input parameters

Parameters	Data type	Description
deltaT	LREAL	Equidistant distance between two measured values. (e.g. 1s)

Input/output parameters (InOut)

Parameters	Data type	Description
values	ARRAY[*] of LREAL	Values that will be included in the differentiation.
derivatedValues	ARRAY[*] of LREAL	The differentiated value range.

Output parameters

Parameters	Data type	Description
error	BOOL	FALSE: No error TRUE: An error occurred during the execution of the FB.
status	WORD	16#0000-16#7FFF: Status of the FB, 16#8000-16#FFFF: Error identification (see following Table).

Status and error displays

status	Meaning	Remedy / notes
16#0000	No error	Processing was completed successfully
10#8200	Error: “deltaT” = 0	“deltaT” can’t be 0.
16#8400	Unequal array sizes	The arrays “values” and “derivatedValues” must have the same size.
16#8401	Too few values	The block requires five values to calculate a differentiated value. Increase the size of the array at the input parameter “values”.

Principle of operation

To calculate the difference quotient of a scattering signal, a third degree compensation polynomial is first placed through the measured values. This polynomial is then differentiated. With this method, even a distorted input signal can be sensibly differentiated.

The difference quotient is calculated with the following formula:

$$\dot{\tilde{y}}(n) = \frac{1}{12deltaT}(y(n-2) - 8y(n-1) + 8y(n+1) - y(n+2))$$

deltaT: equidistant distance between two measured values (e.g. 1s).

The function (FC) can calculate N-4 differentiated and smoothed measured values from N measured values. The output array would be assigned with 0 in the index (0,1,N-1,N). However, the following formalisms can be used to calculate substitute values:

$$\dot{\tilde{y}}(n-2) = \frac{1}{84deltaT}(-125y(n-2) + 136y(n-1) + 48y(n) - 88y(n+1) + 29y(n+2))$$

$$\dot{\tilde{y}}(n-1) = \frac{1}{84deltaT}(-38y(n-2) - 2y(n-1) + 24y(n) + 26y(n+1) - 10y(n+2))$$

$$\dot{\tilde{y}}(n+1) = \frac{1}{84\mathrm{d}deltaT}(10y(n-2) - 26y(n-1) - 24y(n) + 2y(n+1) + 38y(n+2))$$

$$\dot{\tilde{y}}(n+2) = \frac{1}{84deltaT}(-29y(n-2) + 88y(n-1) - 48y(n) - 136y(n+1) + 125y(n+2))$$

deltaT: equidistant distance between two measured values (e.g. 1s).

Further information on libraries in TIA Portal:

- Topic page libraries
  https://support.industry.siemens.com/cs/ww/en/view/109738702
- Guideline on Library Handling
  https://support.industry.siemens.com/cs/ww/en/view/109747503
- Programming Guideline for S7-1200/1500 in chapter “Libraries”
  https://support.industry.siemens.com/cs/ww/en/view/81318674
- Programming Styleguide
  https://support.industry.siemens.com/cs/ww/en/view/81318674