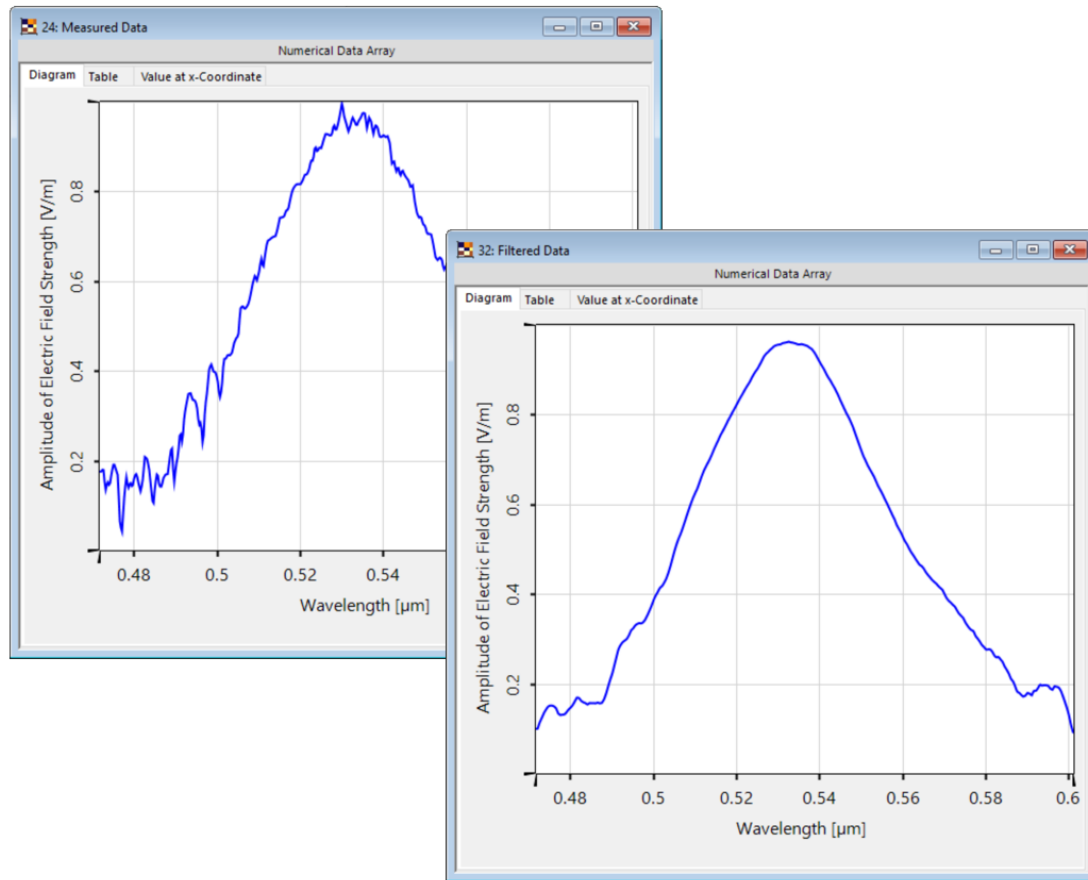


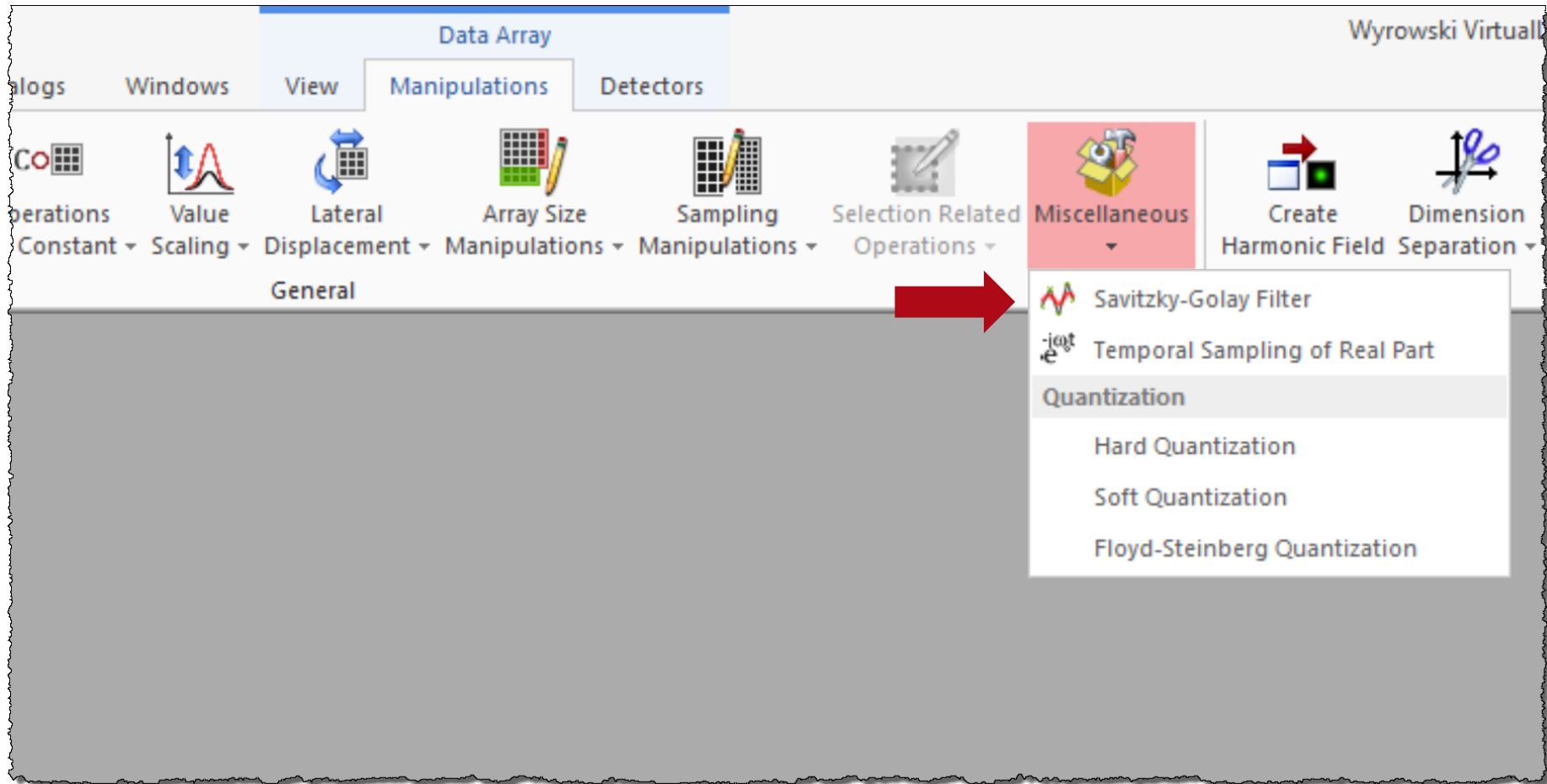
# Savitzky-Golay Filter Function

# Abstract



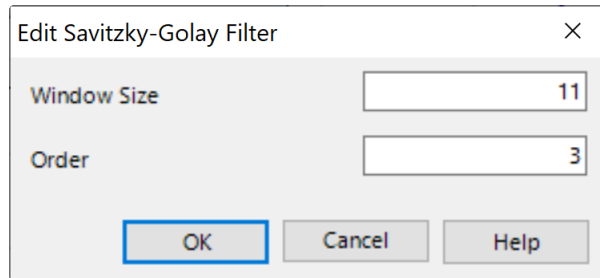
In case of measured signals or data it is hard, if not impossible, to completely avoid all the possible sources of noise which can muddy any experimental measurement. But the presence of noise can perturb important characteristics of the data (e.g. the FWHM of a measured spectrum). Hence, it might be helpful to have some postprocessing tricks up one's sleeve. Here we talk about just one such tool: the Savitzky-Golay filter, which smooths out local noise by performing a regression algorithm on groups of sampling points. In this example, we discuss the options and effects of this feature in VirtualLab Fusion along the example of the measured spectrum emitted by a green LED lamp with 60 nm bandwidth.

# How to access the Savitzky-Golay Filter

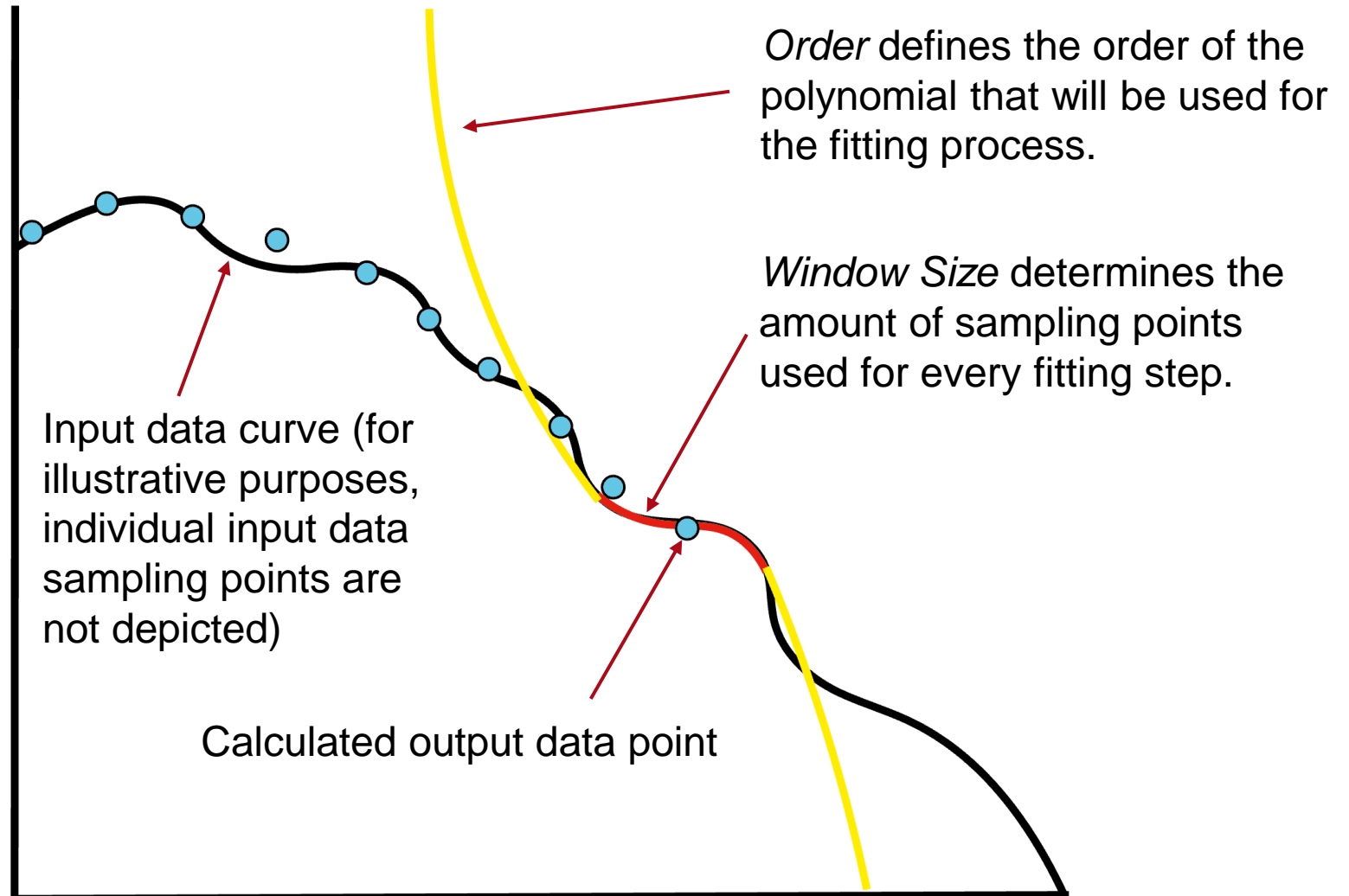


For every real-valued data array the *Savitzky-Golay Filter* can be found under *Manipulations* → *Miscellaneous* → *Savitzky-Golay Filter*

# Visualization of the Filter Function

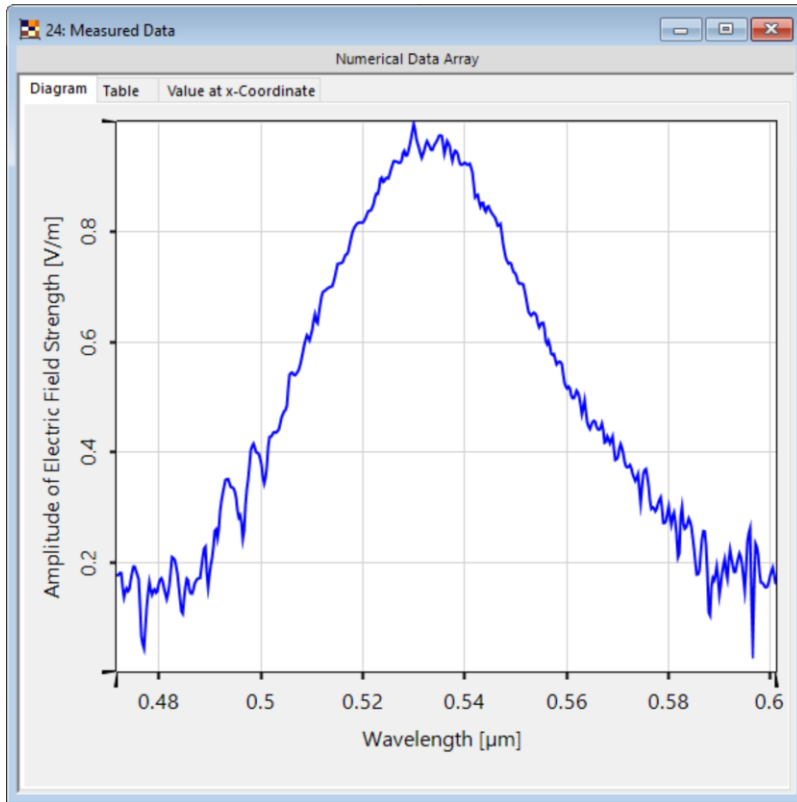


The filtering process entails fitting a polynomial of a certain order to groups of sample points. The number of sampling points considered in a group is defined by the *Window Size* parameter while *Order* controls the order of the used polynomial. The central point of each group is replaced by the value predicted at the same position by the fitted polynomial.

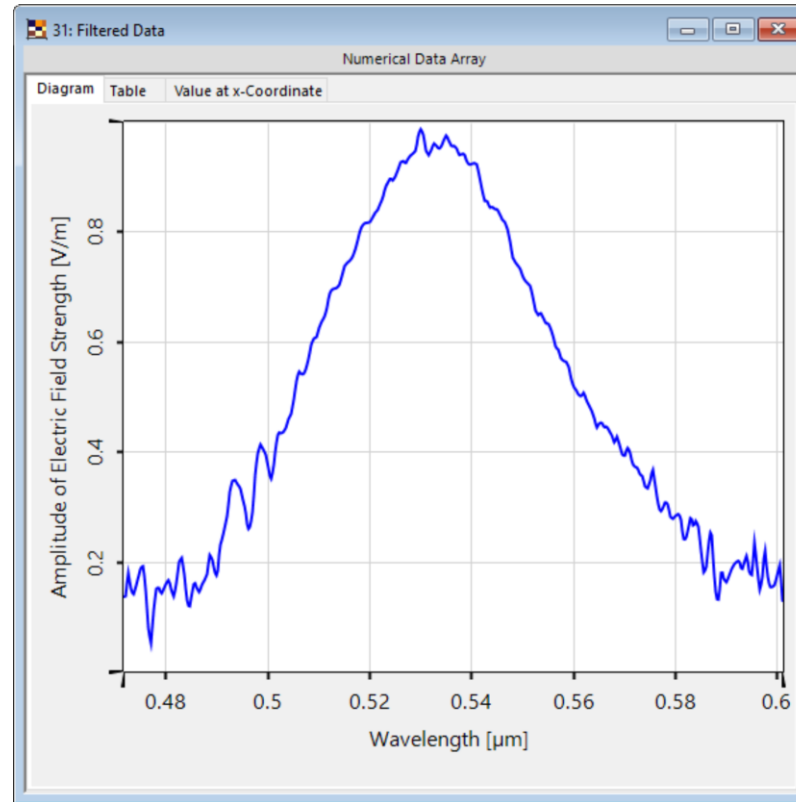


# Effects on the Filter – Window Size

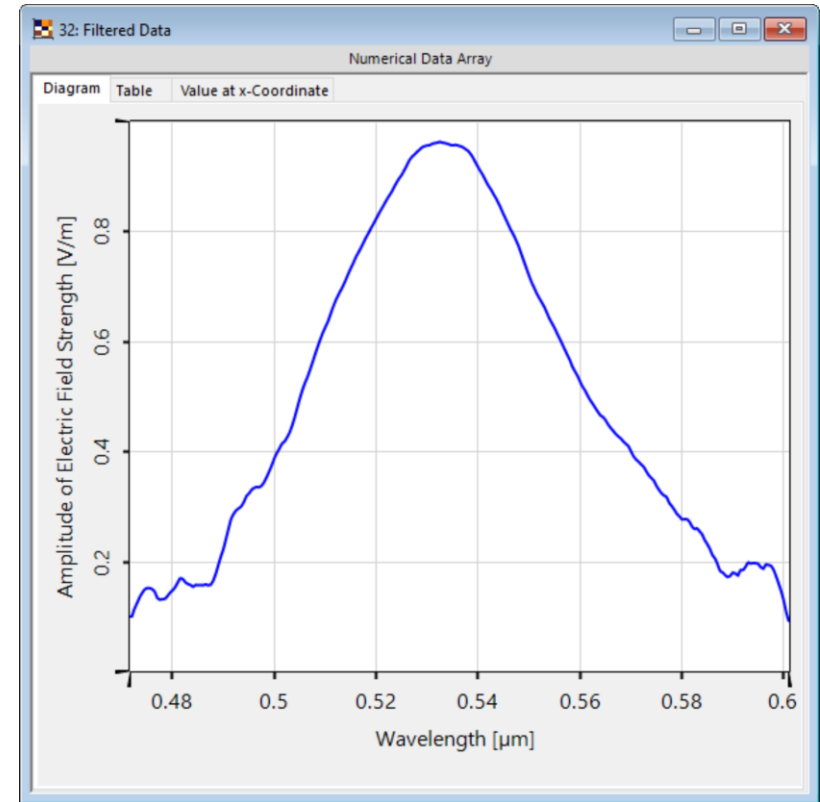
A Larger *Window Size* results in more sampling points being considered in the fitting process, hence a smoother curve.



Amplitude of measured spectrum



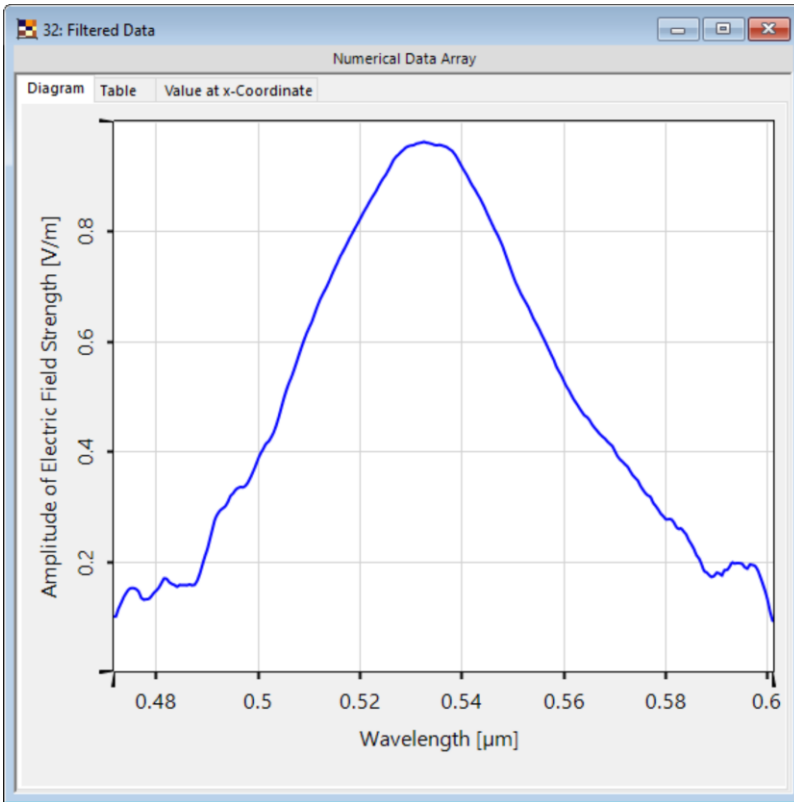
Filtered function with  
Window Size = 5  
Order = 2



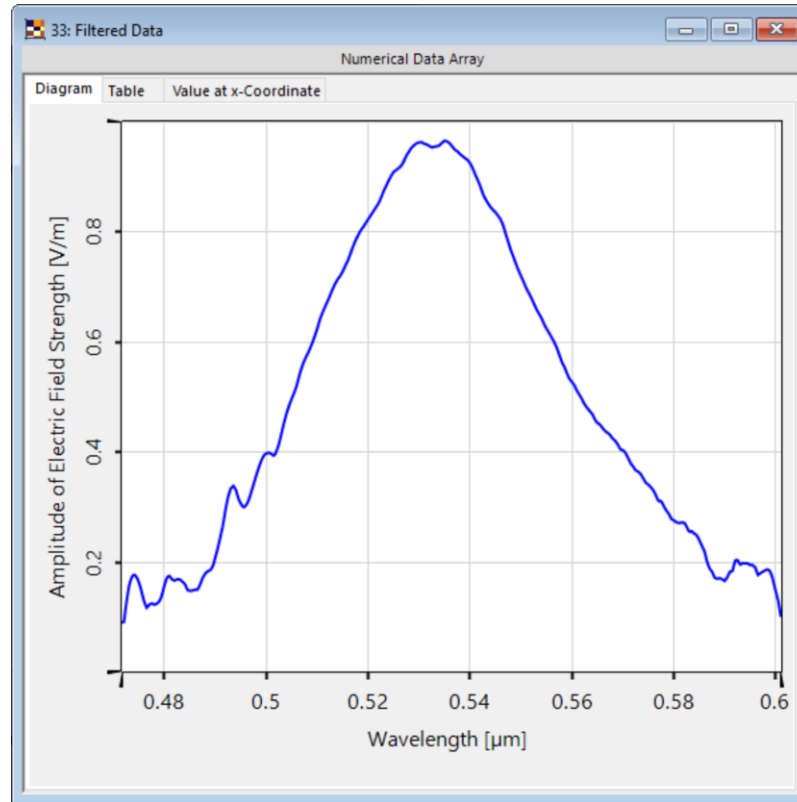
Filtered function with  
Window Size = 21  
Order = 2

# Effects on the Filter – Orders

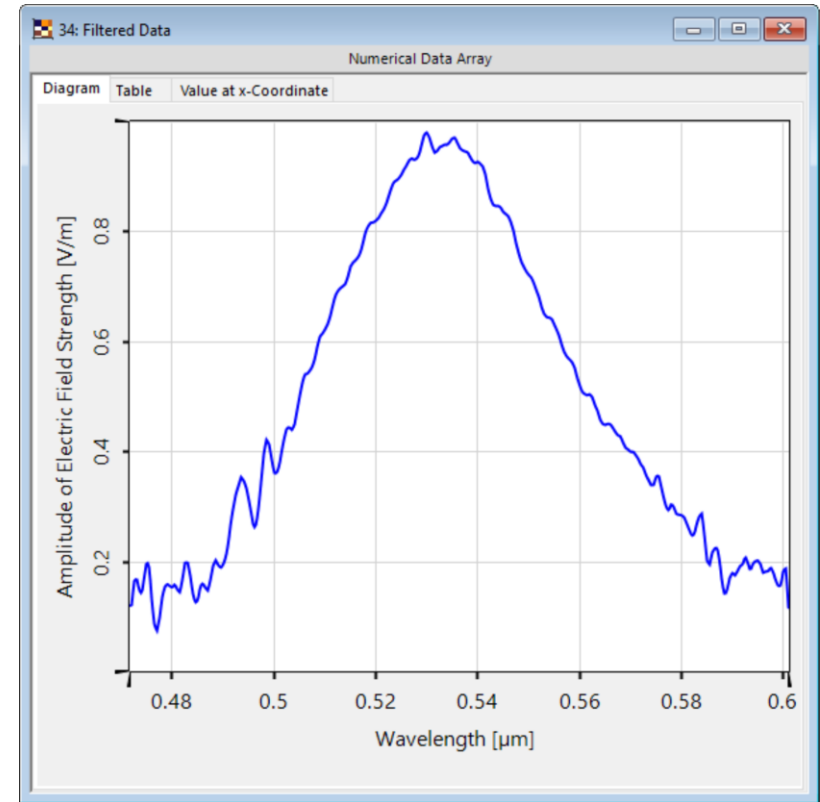
A higher order allows for more detailed curves, but conversely can also preserve local noise.



Filtered function with  
Window Size = 21  
Order = 2

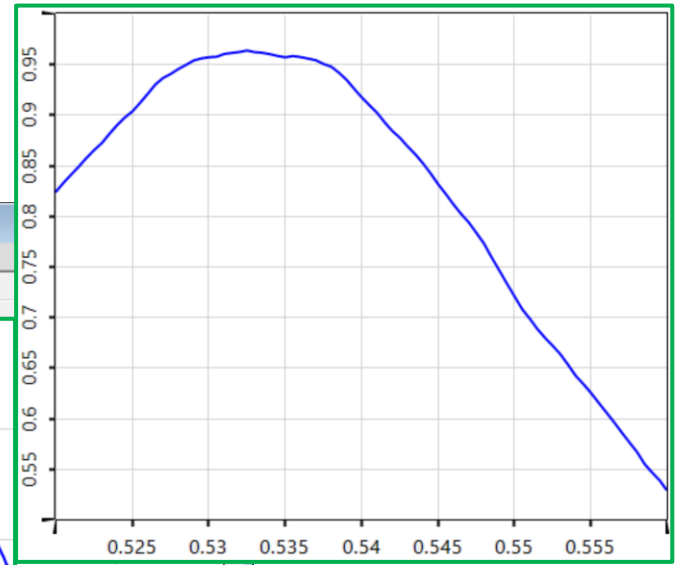
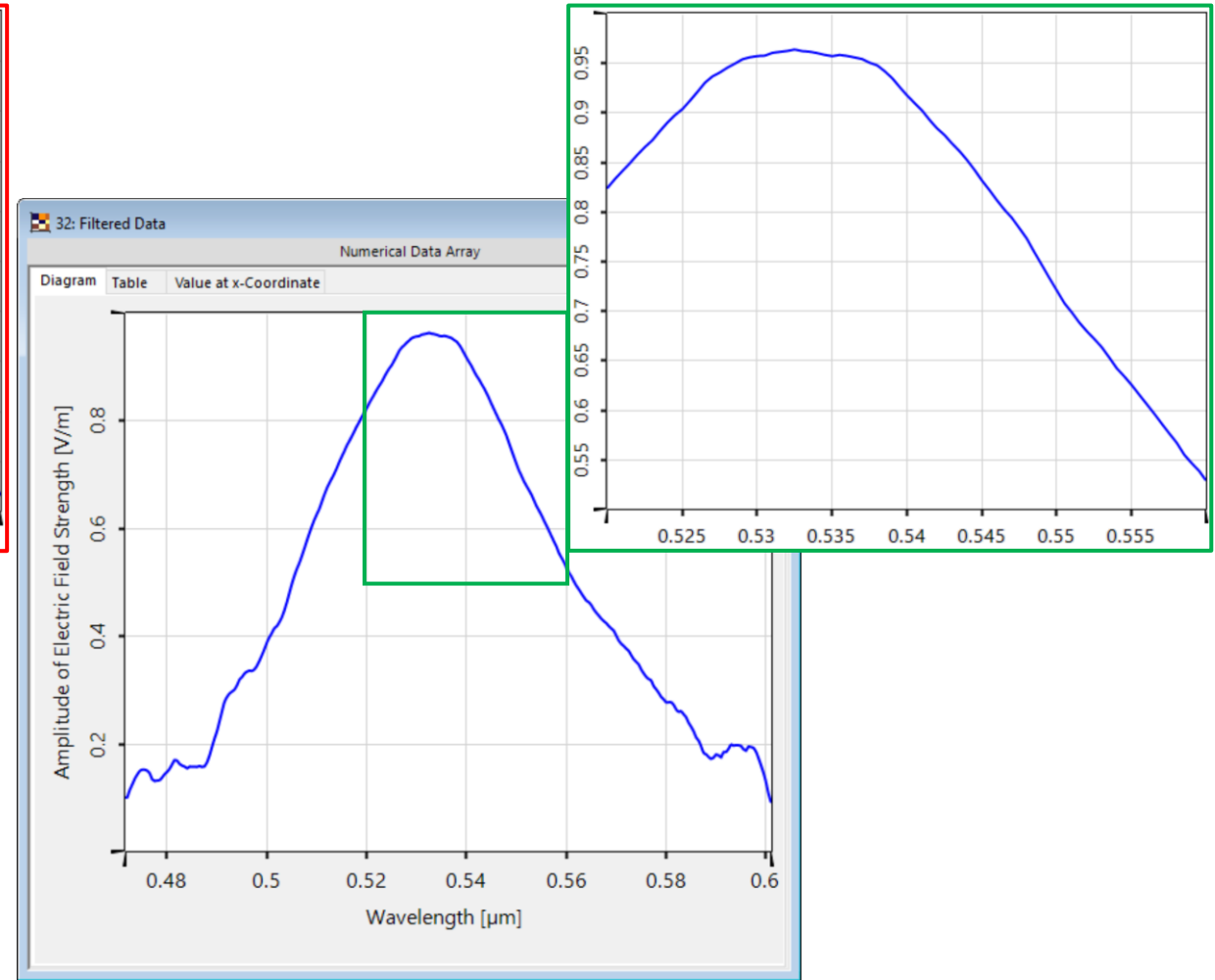
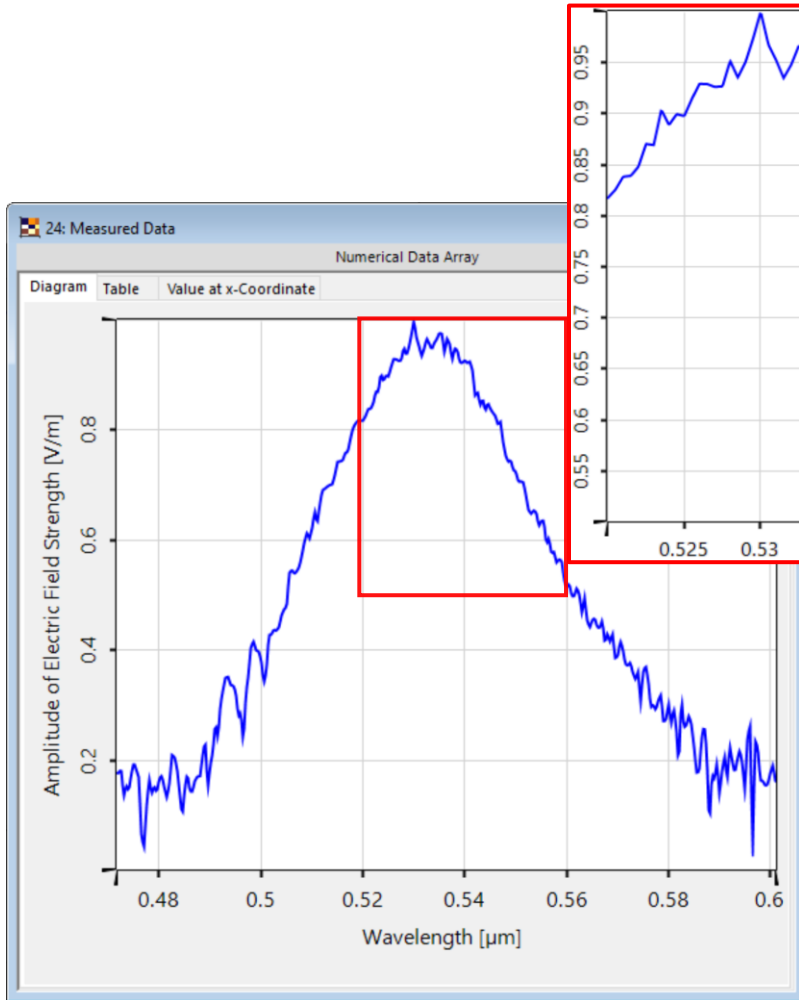


Filtered function with  
Window Size = 21  
Order = 5

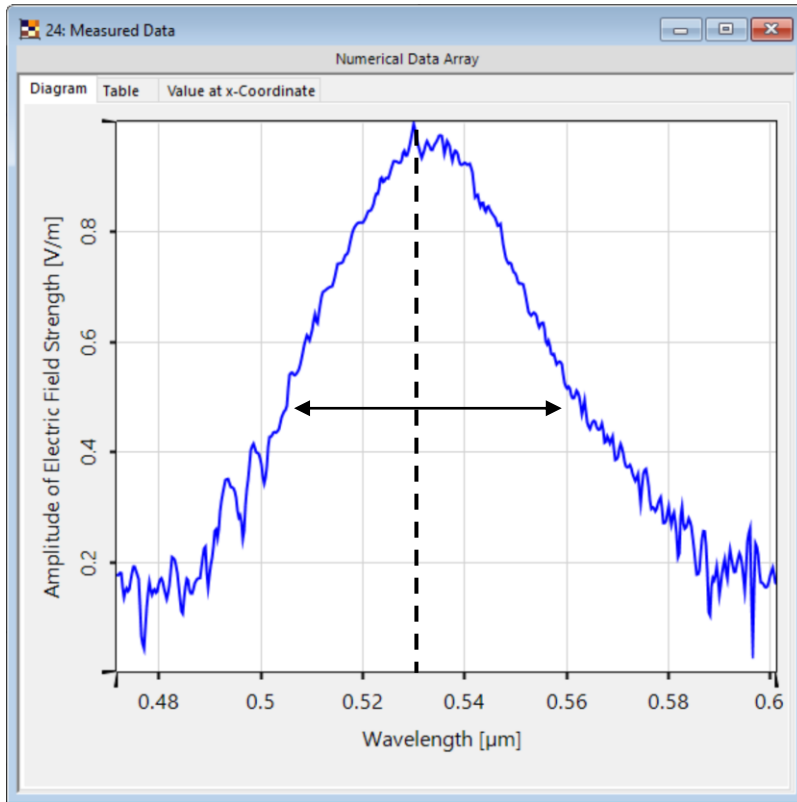


Filtered function with  
Window Size = 21  
Order = 10

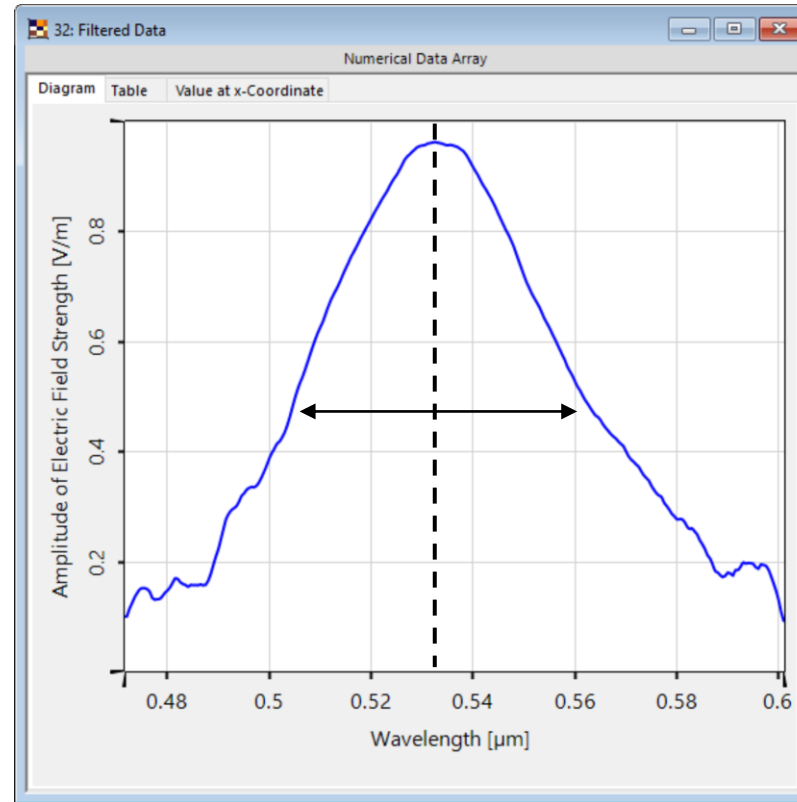
# Local Noise Filtering



# FWHM Detection

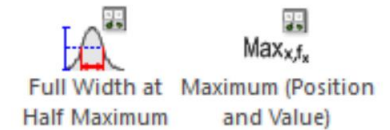


FWHM: 55.8nm  
Peak frequency: 530nm



FWHM: 58.4nm  
Peak Frequency: 532.5nm

VirtualLab Fusion provides multiple tools to evaluate characteristics of fields, such as *FWHM* and *Maximum* detectors.

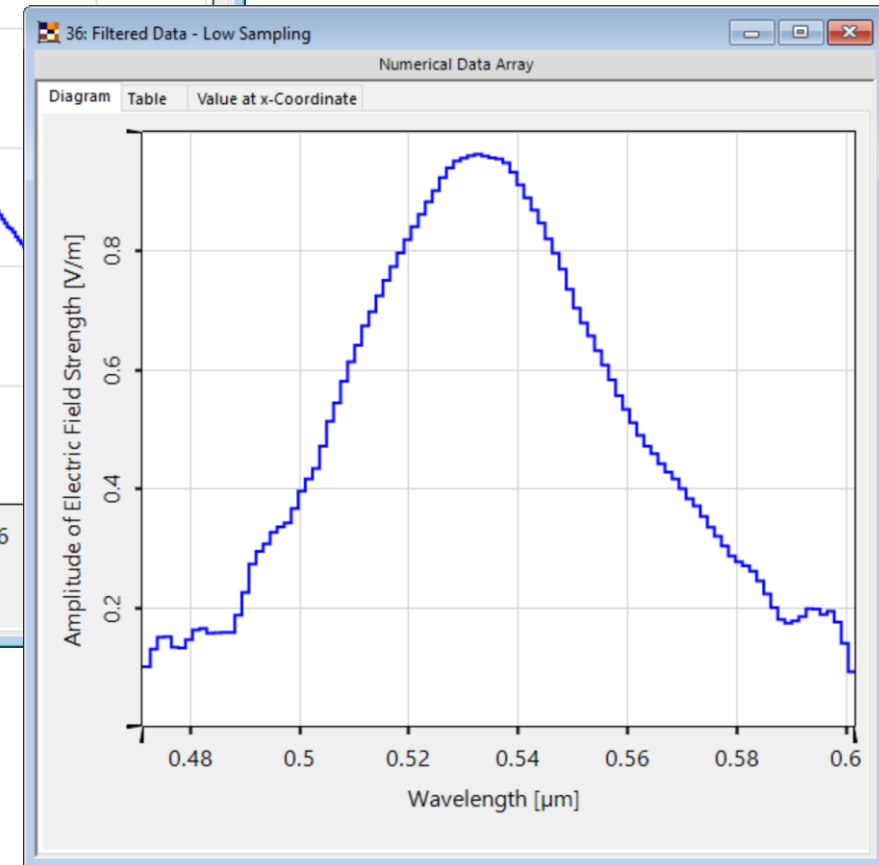
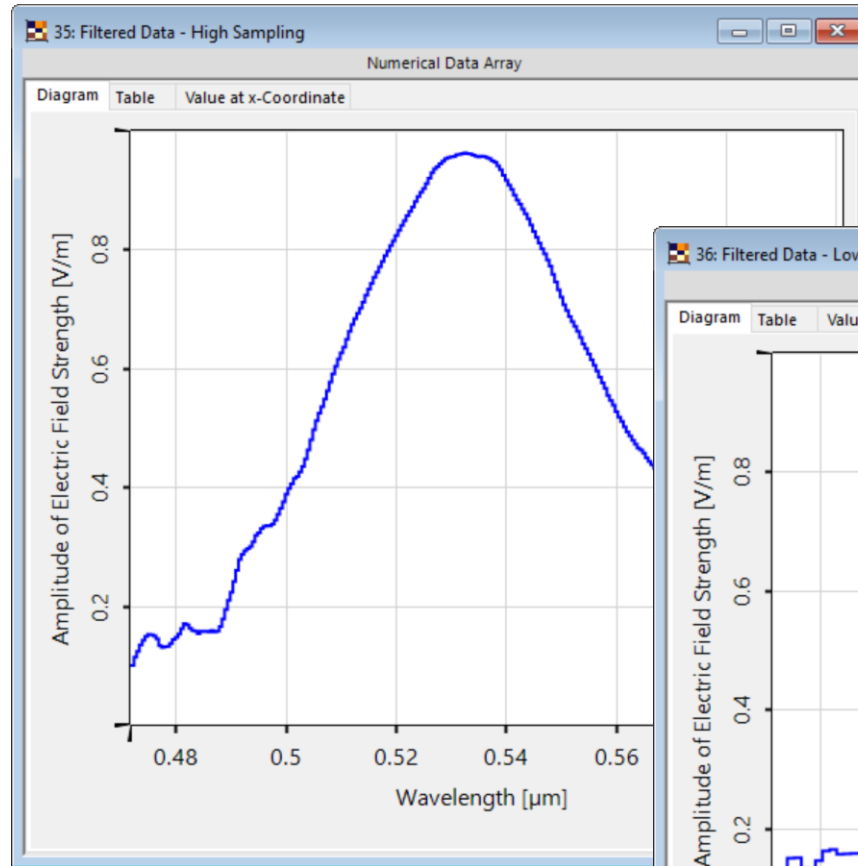
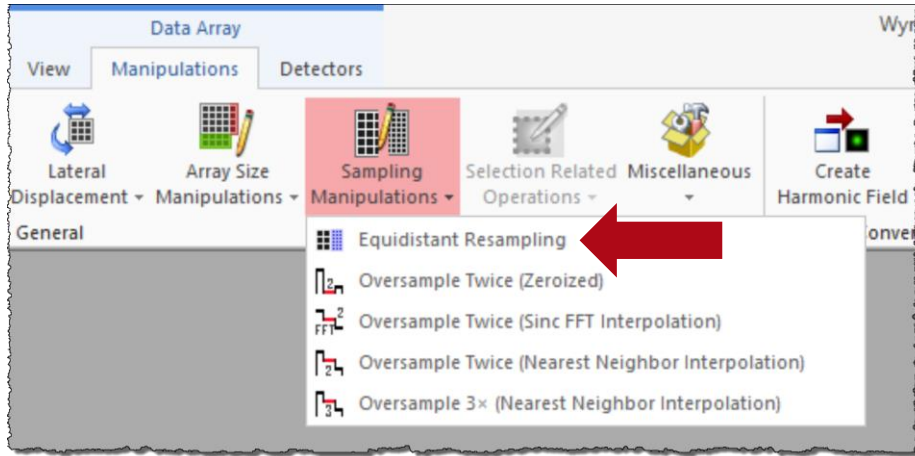


Through the noise in the measured data those characteristics may be falsified. Filtering the data with the Savitzky-Golay filter can help elaborate the underlying curve and improve the detection of said fundamental characteristics.



# Equidistant Resampling

By design, the algorithm keeps the numbers of sampling points constant after the filtering process. For a desired simulation, the number of wavelength samples might be crucial to model an intended optical effect adequately. Therefore, it is possible to resample the result to optimize the numerical effort and accuracy of a potential simulation.



# Document Information

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title	Savitzky-Golay Filter Function
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software version	2021.1 (Build 1.180)
category	Feature Use Case
further reading	- <a href="#"><u>Import of a Light Source with the Spectrum of the Sun</u></a>