

# Legendre polynomials as a recommended basis for numerical differentiation in the presence of square summable or stochastic white noise

Sergei Pereverzyev<sup>1</sup>

<sup>1</sup>Radon Institute for Computational and Applied Mathematics,  
Linz, Austria. e-mail: sergei.pereverzyev@oeaw.ac.at

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## Abstract

We consider one of the classical ill-posed problems: estimating the derivative of a function from its observable version contaminated by additive square summable or stochastic white noise. In the talk we are going to present and analyze an efficient method for the reconstruction of the derivative by the derivatives of the partial sums of Fourier-Legendre series of noisy function. We argue that in certain relevant cases this method has advantage over the standard approach, when the derivative is reconstructed as the solution of the corresponding ill-posed Volterra equation. Another interesting observation is that in a Hilbert scale generated by the system of Legendre polynomials the stochastic white noise does not increase, as it might be expected, the loss of accuracy compared to the deterministic noise of the same intensity. Moreover, we discuss the relation of the considered numerical differentiation scheme with the well-known Savitzky-Golay derivative filters, as well as possible applications in diabetes technology.