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Theory and Practice – Is there any Relationship?

Chromatic Derivatives and Expansions with Weights

A bandlimited signal, $f(t)$ with finite energy can be represented by different series expansions. As an analytic function, it can be represented by its Taylor series, as an L^2-function, it can be expanded to some Fourier series, and by the Whittaker-Shannon-Kotel'nikov sampling theorem it can be represented in the form

$$f(t) \sim \sum_{n=-\infty}^{\infty} f(n) \frac{\sin \pi(t-n)}{\pi(t-n)}.$$

The notion of chromatic derivatives and chromatic expansions have recently been introduced by A. Ignjatović (2001; J. of Fourier Analysis and Appl., 2007). This alternative representation is possessed of some useful properties as follows. It is of local nature as Taylor series, but it can be handled numerically much better than the Taylor expansion. In some cases it is a Fourier series in some Hilbert space, or its fundamental system of functions forms a Riesz basis or a frame, furthermore its fundamental system of functions is generated by a single function as Gabor or wavelet systems. The chromatic series expansions of signals associated with Fourier transform have several practical applications.

The extension of the method to more general integral transforms, differential operators and weighted spaces was introduced by A. Zayed (Trans. of the Amer. Math. Soc., 2014). This type of generalization pays our attention for instance the connections between chromatic derivatives and the Mellin transform which technique can be applied to study the asymptotic behavior of Fourier transforms of orthogonal polynomials.

The recent development of the topic has two different directions: introducing some practically useful methods (A. Ignjatovic, C. Wijenayake, G. Keller, Chromatic Derivatives and Approximations in Practice (I, II) IEEE Transactions on Signal Processing 66 1448-1525 March, 2018), and generalization of the underlying theory (H Calcolo 54 1265-1291 Dec., 2017).

Besides describing the original and new methods we find some open questions in connection with convergence.

Приглашаются все желающие!