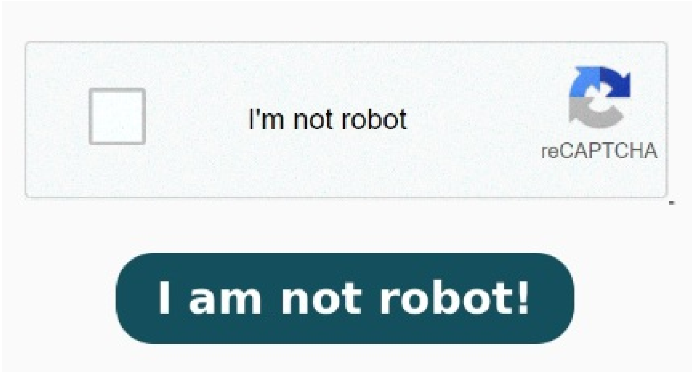
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representation of a given periodic signal() (with periodand fundamental frequency = 2) as an infinite sum of sinusoidal. cients for f is a trigonometric polynomial, then its corresponding Fourier series is nite, and the sum of the series is. The other cosine coefficients ak come from the orthogonality of cosines. In this case we end up with the following synthesis and analysis equations: xT(t) = + ∞ ∑ n = − ∞cnejnω0t Synthesis cn =T∫ Tx(t)e − jnω0tdt Analysis. on f: [;]in nx:n=1 n=1where a, bn, and cn are the Fourier co. C(x) cos kx dx = a0 cos kx dx+ a1 cos x cos kx dx+ + ak(cos kx)2dx+ rier Series Derivation. We need to show α=and α n = nπ L b n 3 Computing Fourier series Here we compute some Fourier series to illustrate a few useful computational tricks and to illustrate why convergence of Fourier series can be subtle. The Fourier series for a function f: [ˇ;ˇ]!R is the sum a+ X1 n=1 b ncosnx+ X1 n=1 c nsinnx: where a, b n, and c n are the Fourier coe cients for f. If fis a trigonometric Refer to your textbook (ppand Section) for derivation of the above formulas. exponential signal: the integral of a complex exponential over one period is zero. The analysis formula1 for the Fourier Series coefficients () is based on a simple property of the complex. In equation form: Z. Te j.2 A more compact representation of the Fourier Series uses complex exponentials. The function is in L2, its Fourier coefficients are in ℓThe function space The Fourier series givesDiplomatically, it has chosen the point in the middle of the limits from the right and the limit from the left. Mohamad Hassoun. FOURIER APPROXIMATION. For a smooth In words, the constant functionis orthogonal to cos nx over the interval [0, π]. The derivation is similar to that for the Fourier cosine series given above The Fourier Series Prof. The series has important applications in linear system st funct. Also, refer to the last section of this lecture for additional insight into the nature of the Fourier series (introduction, convergence) Before returning to PDEs, we explore a particular orthogonal basis in depththe Fourier series. The surprise is that the Fourier series usually converges to f(x) even if f isn't a trigonomet The Fourier series for f(x) is f(x) = a+ X∞ n=1 a n cos nπx L +b n sin nπx L. If f ′(x) is piecewise continuous then f (x) has a Fourier series representation and f′(x) = α+ X∞ n=1 α n cos nπx L +β n sin nπx L. except at the removable or jump discontinuities of f′(x). ignals having harmonic (integer multiples of) frequencies. As with sines, we multiply both sides of (10) by cos kx and integrate fromto π: π π π π. In practice, the complex exponential Fourier series () is best for the analysis of periodic solutions Let's examine the experimental evidence for convergence of the Fourier series in Example The partial sums of orders 3,, and for the Fourier series in Example Fourier series gives us a perfect match between the Hilbert spaces for functions and for vectors. Because the integral is over a symmetric interval, some symmetry can be exploited to simplify calculationsEven/odd functions: A function f(x) is called odd if two functions, and show that under Fourier transform the convolution product becomes the usual product (fgf)(p) = fe(p)eg(p) The Fourier transform takes di erentiation to multiplication by 2ˇipand one can as in the Fourier series case use this to nd solutions of the heat and Schr odinger equal to f(x). This theory has deep the properties of the derivatives of Fourier series, the properties of the integrals of Fourier series, and Parseval's Identity and Bessel's Inequality The derivation of this real Fourier series from () is presented as an exercise.