Rotational Derivative

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Rotational Derivative: A Prototype Idea

This document describes a non-rigorous, experimental idea for a rotational analog of the derivative applied to sinusoidal functions like $\sin(cx)$.

The hypothesis is that repeated differentiation corresponds to rotation in the complex plane, and that a general form of the n^{th} derivative of $\sin(cx)$ may follow the form:

$$D^n[\sin(cx)] = c^n \cdot \sin\left(cx + n \cdot \frac{\pi}{2}\right)$$

Motivation: This form encodes both amplitude scaling and phase shifting as functions of n. I am exploring whether this rotational framework can be extended to define fractional derivatives of sinusoidal functions, and possibly more general functions.

Disclaimer: This is a speculative, non-rigorous exploration. I am not yet sure if this idea aligns with existing fractional calculus as I have only taken up to differential equations (ODEs), intro to prob and stats, and multivar and vector calc.

Implementation: A simple MATLAB script is included to test the formula numerically at specific input values of x, c, and θ.

Figure 1: Software properly returning the 0th derivative