Exponential wave and sinusoidal wave comparison

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This extract evaluates wave equations using exponential methods in comparison to traditional sinusoidal methods. This method also evaluates the possible wave particle duality equation. Requirements are knowledge on complex numbers and the properties of wave equations with a brief view into electromagnetic applications.

INTRODUCTION

EXPONENTIAL FUNCTION

We begin with defining factorial as,

$$x! = x(x-1)(x-2)...(3)(2)(1), \tag{1}$$

exponential function is then,

$$exp(x) = (\Sigma_{k=0}^{\infty}\frac{1}{k!})^x. \tag{2}$$

EXPONENTIAL WAVES

When considering a circle we utilise radius and circumference. The ratio between these two lengths is 2π. However, note that circumference is a Polar measurement as it is a curve while radius is Cartesian as it is a straight line.

$$iC/2r = \pi, \tag{3}$$

$$C/r = -2\pi i. \tag{4}$$

Thus to be mathematically correct we get equations 3 and 4. If equation 3, has no i, circumference would also be a straight line similar to the radius and so 2π is the ratio between two straight lines.

In order to repeat this ratio for lengths of greater magnitude we multiply by frequency f as follows,

$$f(C/r) = -2\pi f i, \tag{5}$$

$$exp(fC/r) = exp(-2\pi f i). \tag{6}$$

$$y = Wexp(fCx/r) = Wexp(-2\pi f i x). \tag{7}$$

By observing equation 5 as a relativistic exponential in equation 6 we obtain a wave formula with amplitude W, in equation 7. One wavelength can be obtained by setting $f = 1$ and $x = [0, 1]$ as seen in figure 7.

REDEFINING EXPONENTIAL FUNCTION

$$E_c(x) = We^{2\pi f x}, \tag{8}$$

$$E_s(x) = We^{2\pi f x - 0.5\pi i}, \tag{9}$$

$$E_c(x - \frac{i}{4\pi f}) = E_s(x), \tag{10}$$

$$C(x) = We^{2\pi f x i} = E_c(ix), \tag{11}$$

$$S(x) = We^{2\pi f i(x - \frac{1}{4\pi f})} = E_s(ix). \tag{12}$$

BEATS AND WAVE SPECTRUM FORMULA

$$Electromagnetism : S(E_c(x)) = We^{2\pi f i We^{2\pi f x} - 0.5\pi i}. \tag{13}$$

$$Electronicbeats : C(C(x)) = We^{2\pi f i We^{2\pi f x}} \tag{14}$$

$$Organicbeats : S(C(x)) = We^{2\pi f i We^{2\pi f x i} - 0.5i} \tag{15}$$

EXPONENTIALLY MODELLING SINUSOIDAL FUNCTIONS

$$\frac{C(x) + C(-x)}{2} = \frac{We^{2\pi f x i} + We^{-2\pi f x i}}{2}, \tag{16}$$

$$\frac{C(x) + C(-x)}{2} = W\frac{e^{2\pi f x i} + e^{-2\pi f x i}}{2}, \tag{17}$$

$$\frac{C(x)+C(-x)}{2} = WCos(2\pi fx), \tag{18}$$

$$S(x)^2 + C(x)^2 = W^2 e^{2(2\pi fxi - 0.5i)} + W^2 e^{2(2\pi fxi)}, \tag{19}$$

$$S(x)^2 + C(x)^2 = W^2(e^{4\pi fxi - 0.5i} + e^{4\pi fxi}), \tag{20}$$

$$S(x)^2 + C(x)^2 = W^2(\frac{e^{4\pi fxi}}{e^{0.5i}} + e^{4\pi fxi}), \tag{21}$$

$$S(x)^2 + C(x)^2 = W^2 e^{4\pi fxi}(e^{-0.5i} + 1), \tag{22}$$

$$S(x)^2 + C(x)^2 = W^2 e^{(\pi i)(4fx)}(e^{-0.5i} + 1), \tag{23}$$

$$S(x)^2 + C(x)^2 = W^2(-1)^{(4fx)}(e^{-0.5i} + 1), \tag{24}$$

$$S(x)^2 + C(x)^2 = W^2(-1)^{(4fx)}(e^{-0.5i} + 1), \tag{25}$$

$$S(x)^2 + C(x)^2 = W^2(-1)^{(4fx)}(e^{-0.5i} + 1), \tag{26}$$

Discrete exponential growth using (19)

RESULTS

When attempting

In figure 2, an amplitude and frequency of 1 was used.

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In figure 4, an amplitude of 1 and frequency of 2 was applied.

[1] The TensorNetwork Authors Revision. *Basic Introduction to Matrix Product States.* (2019). `https://tensornetwork.readthedocs.io/en/latest/basic_mps.html`.

[2] Stavros Efthymiou, Jack Hidary and Stefan Leichenauer. *TensorNetwork for Machine Learning.* (2019). `https://arxiv.org/pdf/1906.06329.pdf`.

[3] E.M.Stoudenmire and David J.Schwab. *Supervised Learning with Tensor Networks.* (2016). `https://proceedings.neurips.cc/paper/2016/file/5314b9674c86e3f9d1ba25ef9bb32895-Paper.pdf`.

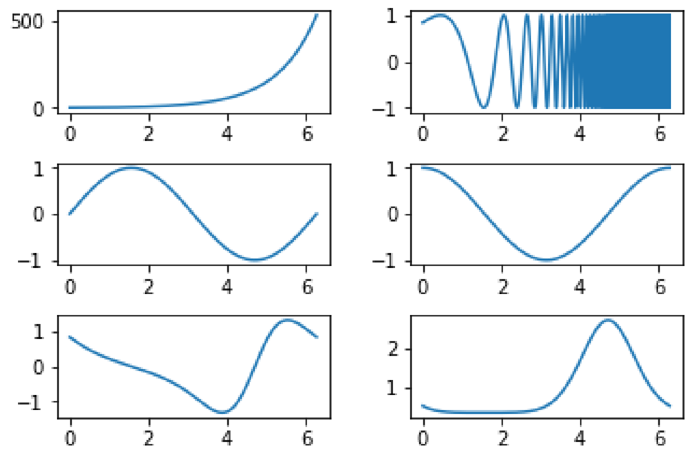

FIG. 1. Top left we have exponential function seen in equation.

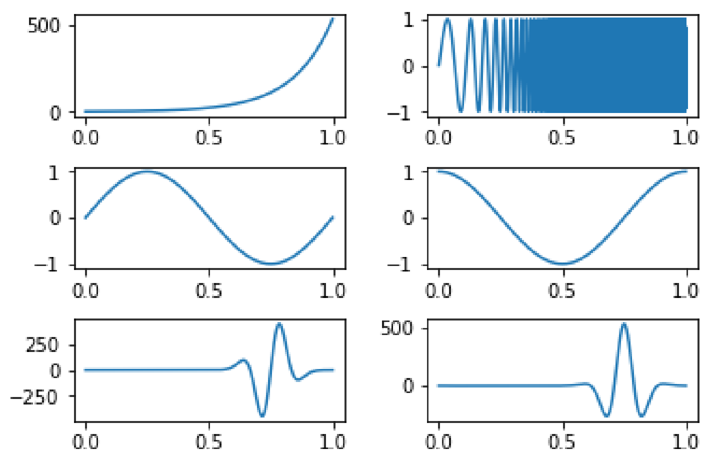

FIG. 2. Top left we have exponential function seen in equation.

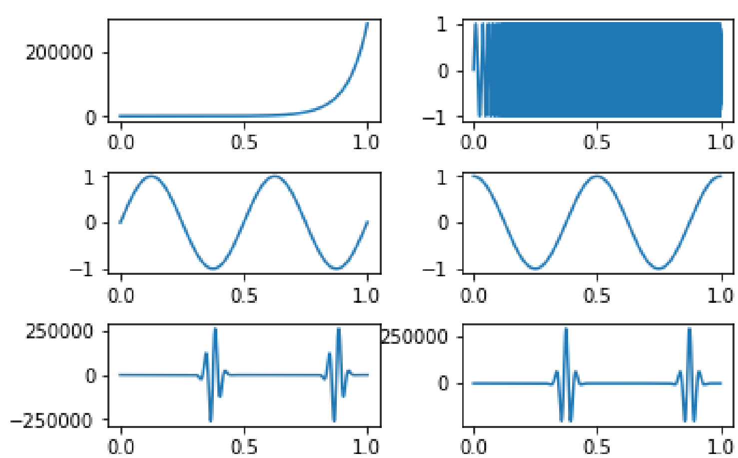

FIG. 3. MPS constructed for 100 elements with 1 bond dimension and 2 feature map dimensions.

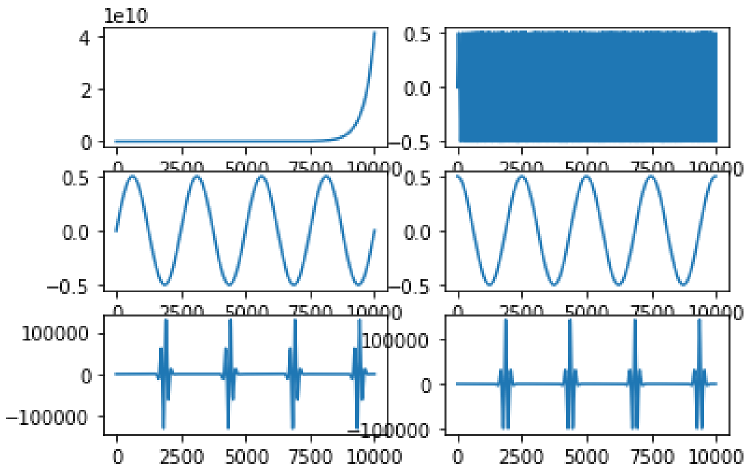

FIG. 4. MPS constructed for 100 elements with 1 bond dimension and 2 feature map dimensions.

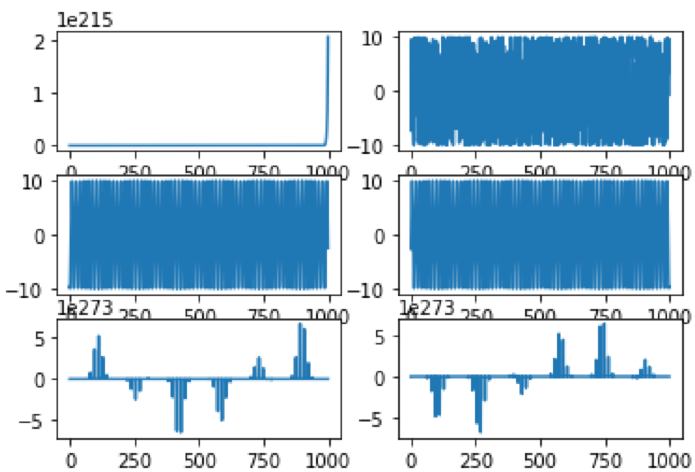

FIG. 5. Frequency of 10 is used.

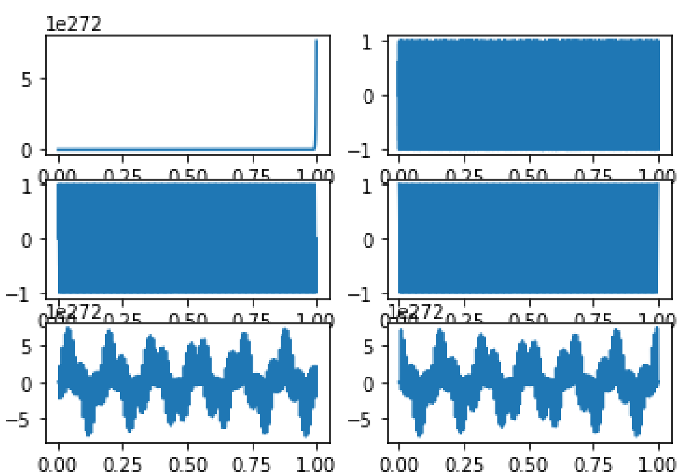

FIG. 6. Frequency of 10 is used.

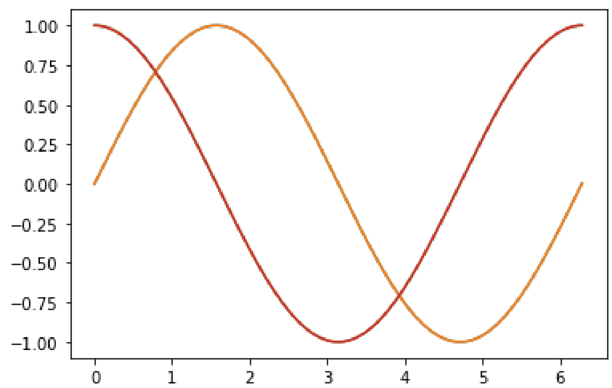

FIG. 7. MPS constructed for 100 elements with 1 bond dimension and 2 feature map dimensions.