Hyper exponential function

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Abstract

I would like to introduce and apply a group of new special functions.

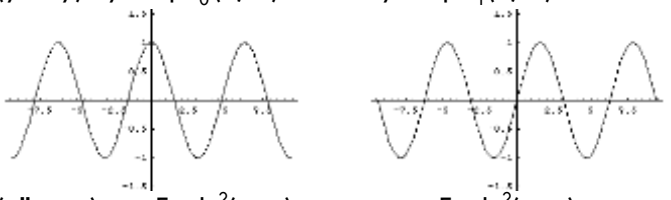
The origins of this study:
If there exist the solution formulas of linear homogeneous differential equations of the second kind with variable coefficients, since the solutions will appear in this world at the same time when the differential equations were described, as a natural consequence, I thought that the solutions may be derived from the differential equations themselves. Therefore, I derived the solutions from the differential equations themselves, in the process,
I discovered the definite structure of functions called second-order Hyper exponential functions today. From this viewpoint, I started to introduce the Hyper exponential functions of n-order and study their applications.

The contents of this presentation:
I define new special functions called Hyper exponential functions with the symbol exph. The main feature of n-order Hyper exponential functions is that n-order derivatives of the functions are the product of any function and the functions. As one of applications, it will be shown that the second-order Hyper exponential functions can be used to describe the solutions of linear homogeneous differential equations of the second kind with variable coefficients. In addition, the special solutions of linear non-homogeneous differential equations of the second kind with variable coefficients will be represented. Several graphs of the Hyper exponential functions of second-order are shown. It will be shown how to generate the Hyper exponential functions of n-order. Computers are used to generate the Hyper exponential functions. The list of the differential equations that describe the solutions by using the Hyper exponential functions will be given. The Hyper exponential functions are used to represent solutions for the wave equations and for nonlinear differential equations.
The important points of the Hyper exponential functions will be shown.

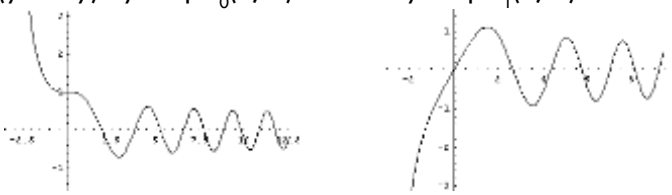
Graphs

Second-kind Hyper exponential functions:

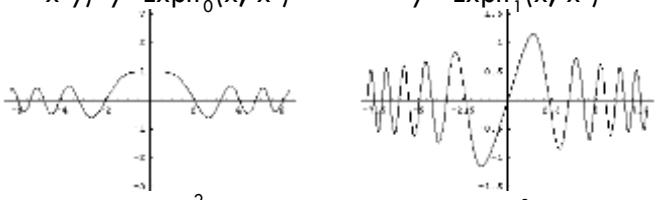
$(y''=-y)$ $y=\mathrm{Exph}_0^2(x;-1)=\cos x$ $y=\mathrm{Exph}_1^2(x;-1)=\sin x$



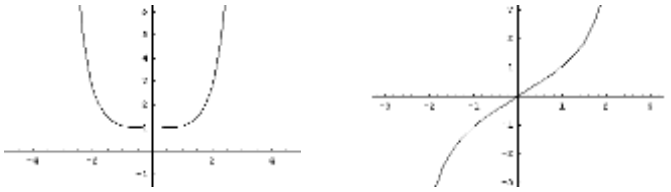
$(y''=-xy)$ $y=\mathrm{Exph}_0^2(x;-x)$ $y=\mathrm{Exph}_1^2(x;-x)$



$(y''=-x^2y)$ $y=\mathrm{Exph}_0^2(x;-x^2)$ $y=\mathrm{Exph}_1^2(x;-x^2)$



$(y''=x^2y)$ $y=\mathrm{Exph}_0^2(x;x^2)$ $y=\mathrm{Exph}_1^2(x;x^2)$



Recent Publications

1. **Kumahara K, Saitoh S, Uchida K (2009)** Normal solutions of linear ordinary differential equations of the second order, International Journal of Applied Mathematics, Volume 22 No.6 2009,981-996.
2. Uchida K (2017) Norml solutions of linear ordinary differential equations of the second order, eBookland. (In Japanese).



Biography (150 word limit)

Keitaroh Uchida has continued to study differential equations. He was awarded a master's degree at the OPEN UNIVERSITY OF JAPAN. He is a software engineer over 30 years. The solutions of the differential equations he invented is expected to be used as standard solutions around the world in the future.

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Notes/Comments: