Using ClassPad-technology in the education of students of electrical engineering (Fourier- and Laplace-Transformation)

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Abstract:
By the help of several examples the interactive work with the ClassPad330 is considered. The student can solve difficult exercises of practical applications step by step using the symbolic calculation and the graphic possibilities of the calculator. Sometimes several fields of mathematics are combined to solve a problem.

Let us consider the ClassPad330 (with the actual operating system OS 03.03) and discuss on some new exercises in analysis, e.g. solving a linear differential equation by the help of the Laplace transformation and using the inverse Laplace transformation or considering the Fourier transformation in discrete time (the Fast Fourier Transformation FFT and the inverse FFT). We use the FFT- and IFFT-function to study periodic signals, if we only have a sequence generated by sampling the time signal.

We know several ways to get a solution. The techniques for studying practical applications fall into the following three categories: analytic, graphic and numeric. We can use the ClassPad software in the handheld or in the PC (ClassPad emulator version of the handheld).

References:
http://edu.casio.com/products/classpad/cp_v302/
http://classpad.net/product/Classpad300/cp_manager_03.html

Example of solving a linear ODE with initial condition, several ways of solution:

The last input line yields in the CAS software:
In the last line we have with $Lp$ the Laplace transformation of $y(t)$, sometimes we denote $Lp$ by $Y(s)$. Furthermore we discover the initial conditions $y(0)$, $y'(0)$, $y''(0)$.

We denote the right hand side of the last equation by $U(s)$ and solve this equation for $Y(s)$:

Now we consider the following example: $a = 1$, $b = -3$, $c = 3$, $d = -1$, $u(t) = \cos(2t)e^{-t}$ and $y(0) = 0$, $y'(0) = 1/32$, $y''(0) = -3/16$.

Finally we see the inverse transformation of the several summands.

The direct way of solution consists in using the dSolve-function:
This exercise shows how to work with the CAS to support the learning process of our students. We can see step by step in the handheld what happens to solve a given problem.

Example of computing a FFT of a sequence generated by sampling the time signal:
Now we have to setup the **Advanced Format** to compute the results in the wished manner:

We use the Advanced Format for FFT with Signal Processing and divide the listf by N or we use the optional Parameter 2 (=Data Analysis) without division the listf by N:
Have a look into the lists (spreadsheet-application)
Consider graphical representations of the absolute values of coefficients:

Graphical representations of the Fourier polynomial: