Engineering Mathematics and CAS

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The computer algebra system TI- Nspire CX CAS will be used to show how some mathema-tical results can be illustrated by a CAS. The talk will make interesting connections between subjects that seem to be different.

The first example will be about odd, even and periodic functions. Beginning engineering students have problems to clearly understand the concept of even functions, odd functions and -much more seriously- the concept of inverse functions. We think the graphical capabilities of Nspire can be used to overcome this problem. The graphic editor of Nspire CAS will guide us to extend functions that are first defined over an interval on one side of the origin: extensions will be even or odd ones. Then the modulo function will be used to extend it periodically. In the case of inverse functions, the important fact is the concept of one to one function and the restriction of the domain of a given function. We will be able to do this very easily because Nspire CAS has nice templates to do such operations.

In the second example, we will use the modulo function and the D'Alembert's solution to solve the one dimensional wave equation in the case of zero initial velocity. We will recall the series solution of this problem, based on the method of separation of variables. Then, the solution will be obtained, using the sum of two opposite waves. If, in addition, we take zero initial velocity, then the solution can be shown to simplify into an odd periodic function: this is where the modulo function will act and an easy animation will be possible and performed. The big advantage over the series solution is trivial: no need to take a partial sum to plot the graph because the infinite series has been simplified into a closed-form.

Finally, we will move to Fourier series in order to connect these two examples. We showed at ACA 2013 how to define a Fourier function in Nspire CAS able to do exactly what the good old Derive software Fourier function is doing. Being able to plot the graph of any periodic function, we will find its Fourier partial sum and plot both graphs on the same window.

Future engineers at our engineering school are not so different from the ones in other parts of the world: they use mathematics as a tool. If they want to be able to *see* rapidly the results of a computation, their portable TI-Nspire CX CAS handheld does the job in the classroom and during exams. Of course, outside the classroom or during a regular course, the software version of Nspire is a more convenient choice.