Laplace Transforms, ODEs and CAS

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ABSTRACT

Mathematics can still be taught without using a CAS and this is probably the case in most schools and universities. Although CAS and technology are often used by instructors to demonstrate or illustrate mathematical concepts, they are rarely used by students. When we consider our mathematics curriculum, "Differential Equations" is one course that we firmly believe can and should benefit from the use of CAS. In this talk, we will report how our ODE course has evolved, as our engineering students have access to technology (Voyage 200 symbolic calculator) in the classroom at all times. This talk will show examples of what students still do by hand and what CAS allows us to do now to enrich the learning experience.

Laplace transform in differential equations is a great subject where CAS can be used in an efficient manner. Starting with the classic definition of the Laplace transform, we already have a nice area to use our CAS, reviewing with students when an improper integral converges. In engineering, we often have to work with piecewise continuous functions, so we introduce the unit step (Heaviside) function and show them how to create it on their Voyage 200 so they can easily plot these type of functions. We still demand that our students learn and work with a basic Laplace transforms table. We have them work, by hand, many of the classic properties of Laplace transform. When comes time to calculate inverse Laplace transforms, we let them use an "Expand" command on their Voyage 200 so they can get directly the result of the partial fraction expansion of rational functions. This being done, they still have to finish manually the inverse process, going back to their table and doing, when needed, the completion of the square for complex roots or using the appropriate property of the table (time-shifting for example). As for solving differential equations with the aid of Laplace transforms, we will show an example where, even with a discontinuous forcing function, the solution can still easily be found with the aid of the CAS and we insist on having them plot this solution. We will complete this presentation by solving a system of differential equations using the Laplace transform method, which is rarely done due to the amount of manual calculations involved.

Keywords

CAS, Laplace transform, Differential equations, Unit step function.