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EXAMPLE OF LuaLaTeX WITH ASMECONF.CLS FOR ODE INTEGRATION

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ABSTRACT

This paper is an example of using asmeconf *with* LuaLaTeX *to solve an ODE initial value problem using a fourth-order Runge-Kutta method and to plot the result using* PGFPLOTS. *The use of a landscape figure is also illustrated. References are given for further reading.*

Keywords: asmeconf, LuaLaTeX, ODE, pgfplots, landscape

NOMENCLATURE

A Constant parameter [–]
t Time [s]
$y(t)$ Position [m]

1. INTRODUCTION

LuaLaTeX is built upon the Lua programming language [1]. By directly using Lua code in a LaTeX file, we can accomplish a wide range of tasks, as illustrated in the open-access paper by Montijano et al. [2]. In the present example, we follow Montijano et al. in solving a nonlinear first-order ordinary differential equation and plotting the result—all within a single LaTeX file!

2. SOLUTION TO AN INITIAL VALUE PROBLEM

We consider an initial value problem like that of Montijano et al.:

$$y'(t) = A \cdot y(t) \cos\left(t + \sqrt{1 + y(t)}\right) \text{ with } y(0) = 1 \quad (1)$$

Here, A is a constant. We may adopt a fourth-order Runge-Kutta algorithm for the integration, which we shall perform to $t = 30$ s using a 400 point discretization. The details of the Runge-Kutta algorithm and a listing of the code are given in Montijano et al. (You can also read the code in the present .tex file.)

The algorithm is implemented directly in the preamble of this file, and the results are plotted in Fig. 1 for $A =$ $\{0.25, 0.5, 0.75, 1.0\}$. Plotting is done using the PGFPLOTS package [3].

Landscape figures may be produced at full-page size by putting `\usepackage[figuresright]{rotating}` (Fig. 1) into your .tex file's preamble and using the sidewaysfigure* environment [4].

3. CONCLUSION

LuaLaTeX enables numerical computations within a LaTeX environment. By combining this capability with PGFPlots, the need for separate numerical and/or graphics packages can be reduced.

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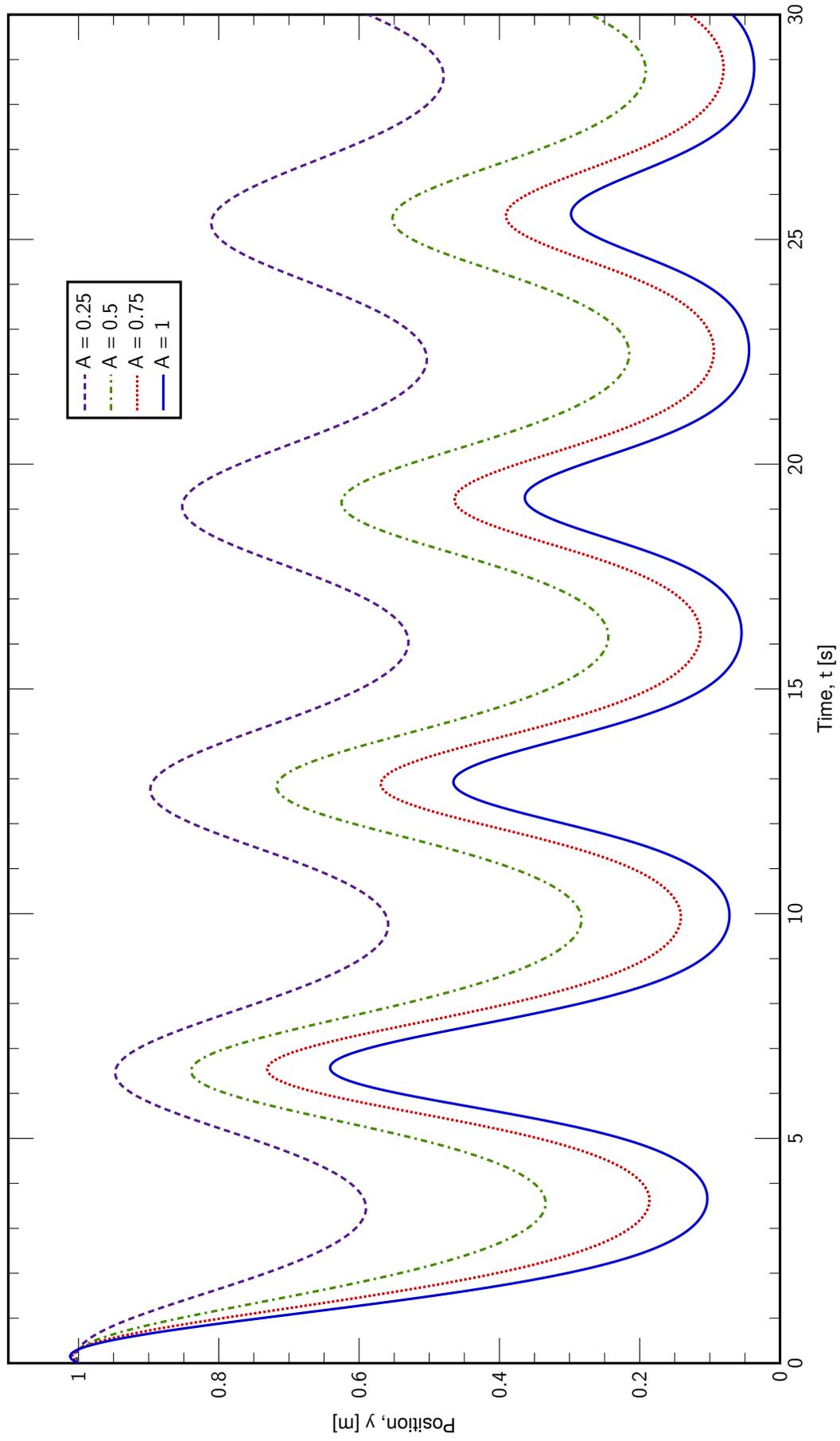
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FIGURE 1: A TRIAL OF PGFPLOT WITH LUACODE RUNGE-KUTTA INTEGRATION