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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.:

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

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.

ACKNOWLEDGMENTS

The example shown in this paper is directly based on an example given by Montijano et al. [2]. Additional examples, such as the Lorenz attractor, are contained in that paper.

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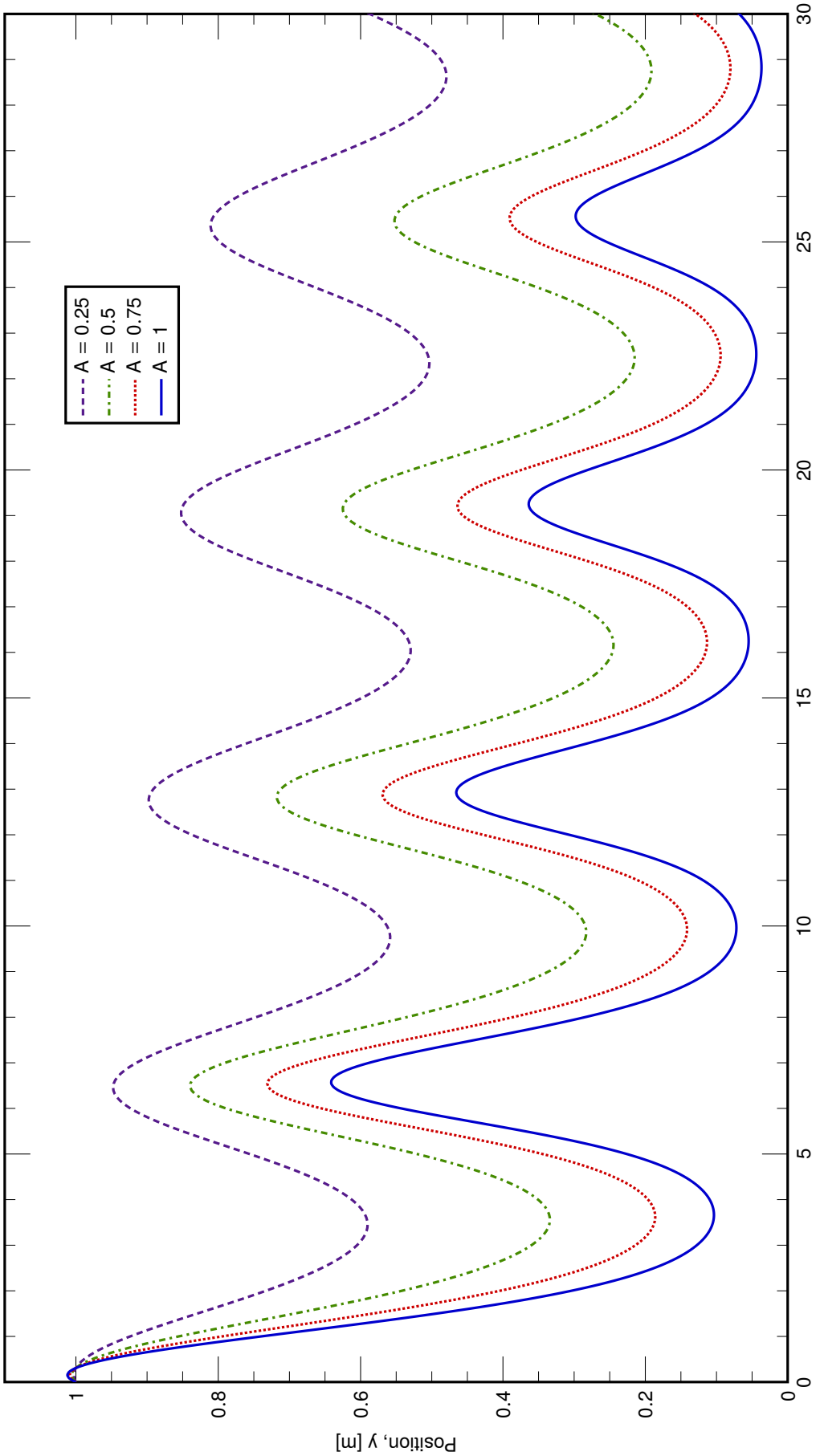

FIGURE 1: A TRIAL OF PGFPLOT WITH LUACODE RUNGE-KUTTA INTEGRATION