Journal of Physics: Conference Series

PAPER • **OPEN ACCESS**

First-order linear partial differential equations using the GeoGebra and GeoGebra 3D graphing calculator

To cite this article: Jorge Olivares Funes *et al* 2021 *J. Phys.: Conf. Ser.* **1730** 012066

First-order linear partial differential equations using the GeoGebra and GeoGebra 3D graphing calculator

Jorge Olivares Funes
Department of Mathematics, Universidad de Antofagasta, Antofagasta-Chile
E-mail: jorge.olivares@uantof.cl

Pablo Martin
Department of Physics, Universidad de Antofagasta, Antofagasta-Chile
E-mail: pmartin@uantof.cl

Elvis R. Valero Kari
Department of Mathematics, Universidad de Tarapac, Arica-Chile
E-mail: evalero@uta.cl

Abstract. In this paper we will show, through various examples of how are the animated solutions of certain linear partial differential equations of the first order with constant homogeneous coefficients through GeoGebra applets designed for a first course of Partial Differential Equations for the engineering careers of the University of Antofagasta-Chile

1. Introduction

Several Authors have already used GeoGebra applets as a teaching element for learning physical sciences and mathematics [1], [2] and [4]. Also some important and key reasons why we use GeoGebra are given by Gabriel Sosa Felipe in [5] which tells us that The use of presentations with GeoGebra applets can improve the methods of exposure by the teacher and allows us to teach using the computer as a motivating element in the classroom along with the activities we can perform.

With these arguments, we set out to build GeoGebra applets as didactic support for teaching and motivating the teaching of first-order linear partial differential equations with constant homogeneous coefficients for engineering students at the University of Antofagasta

This work is the continuation of the teaching and work project "Interactive animations and creations in linear differential equations of the first order: the case of GeoGebra [3].

2. GeoGebra Applets of first-order linear partial differential equations

Below we will show some examples of apples from GeoGebra of first-order linear partial differential equations and its solutions available in https://www.geogebra.org/m/kgbaypwt

Journal of Physics: Conference Series **1730** (2021) 012066 doi:10.1088/1742-6596/1730/1/012066

Example 1 *Be*

$$\frac{\partial u}{\partial x} + b\frac{\partial u}{\partial y} = 0,\ \ u(x,0) = bx + c$$

Whose solutions is $u(x,y) = bx - y + c$*, and is given in Figure 1, with* b *and* c *between -5 and 5*

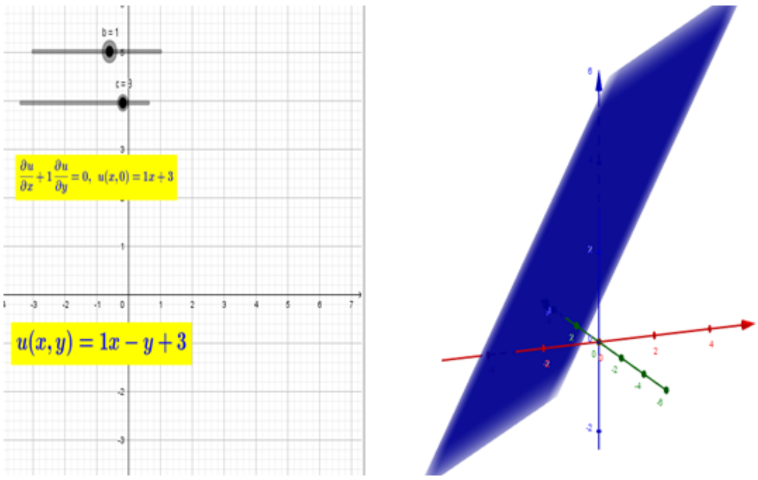

Figure 1.

Example 2 *Be*

$$a\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 0, u(0,y) = y^2$$

Whose solutions is $u(x,y) = \frac{(x-ay)^2}{a^2}$*, and is given in Figure 2, with* a *between 0.5 and 5.*

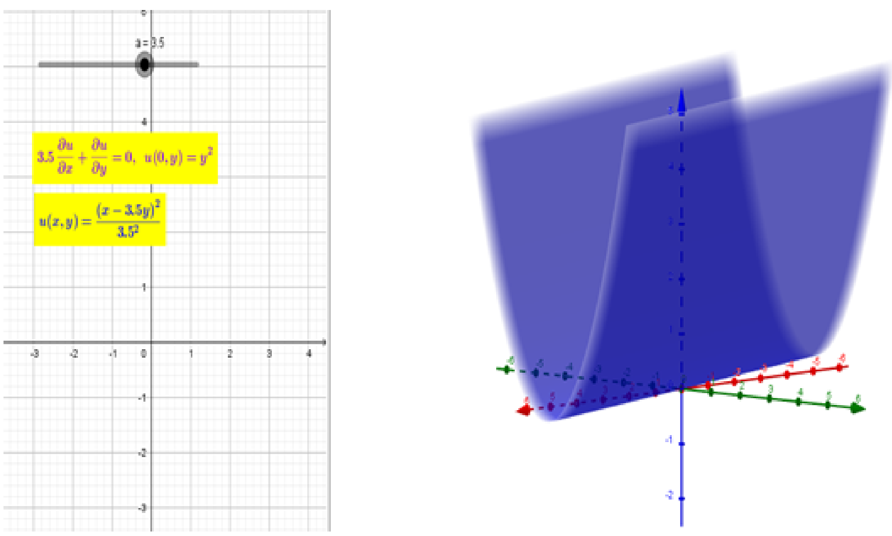

Figure 2.

Example 3 *Be*

$$a\frac{\partial u}{\partial x} + b\frac{\partial u}{\partial y} = 0, \;\; u(x,0) = \cos x$$

Whose solution is $u(x,y) = \cos\left(\frac{bx-ay}{b}\right)$, *and is given in Figure 3 whit a and b between 0.5 and 5.*

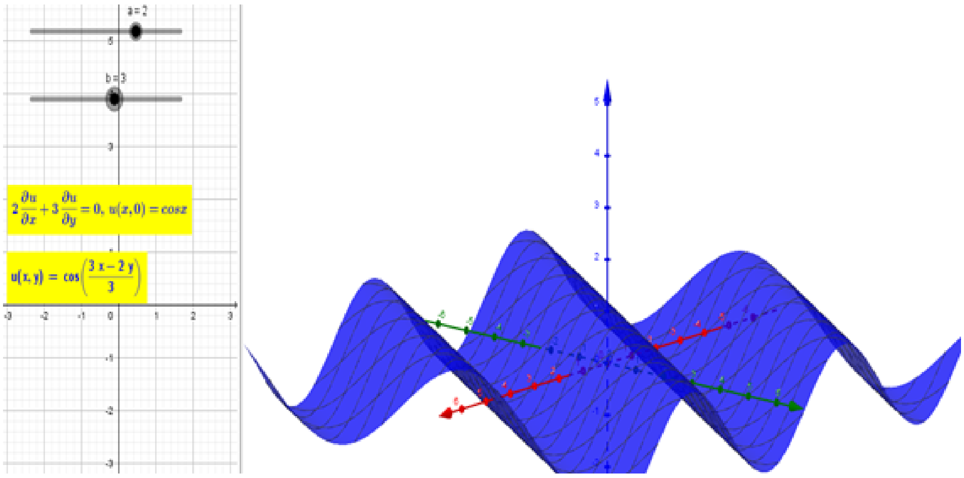

Figure 3.

Example 4 *Be*

$$a\frac{\partial u}{\partial x} + b\frac{\partial u}{\partial y} = 0, \;\; u(0,y) = e^{y}$$

Whose solution is $u(x,y) = e^{\left(\frac{ay-bx}{a}\right)}$, *and is given in Figure 4 whit a and b between 0.2 and 5.*

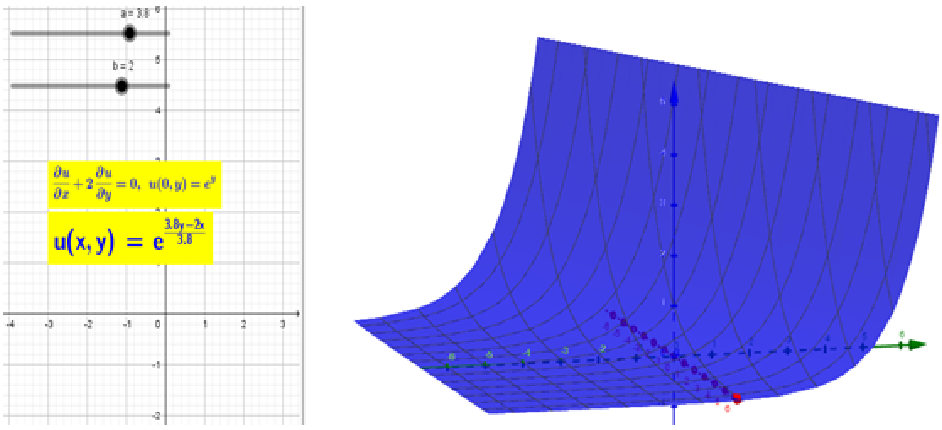

Figure 4.

Example 5 *Be*

$$\frac{\partial u}{\partial x} + b\frac{\partial u}{\partial y} = 0, \;\; u(x, 0) = \sin x$$

Whose solution is $u(x, y) = \sin\left(\frac{bx-y}{b}\right)$, *and is given in Figure 5 whit b between 0.5 and 5.*

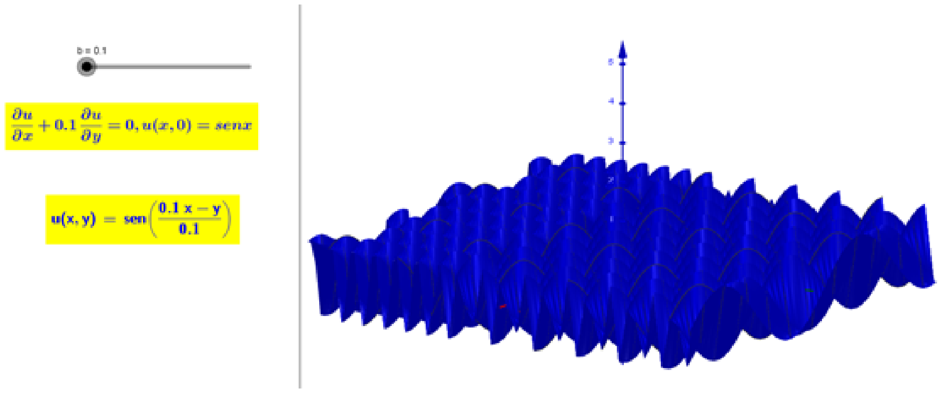

Figure 5.

3. Conclusion

The objective of this work has been to share and show various GeoGebra applets of first-order partial linear differential equations designed as support material for the mathematics courses of engineering careers in the teaching and learning processes

References

[1] Córdoba, Francisco; Castrillón, Elkin; Rojas, Carlos (2015). Geogebra como herramienta de apoyo visual en la solución de problemas de modelación en matemática escolar. En Flores, Rebeca (Ed.), Acta Latinoamericana de Matemática Educativa (pp. 1726-1731). México, DF: Comit Latinoamericano de Matemática Educativa.
[2] Tom Walsh , "Creating interactive physics simulations using the power of GeoGebra". Physics Teacher 55, 316 (2017); doi: 10.1119/1.4981047
[3] Funes Jorge Olivares and Valero Elvis 2018 Animations and interactive creations in linear differential equations of first order: the case of Geogebra IOP Conf. Series: Journal of Physics: Conf. Series 1141 0121264 .
[4] Graciela Caligaris Marta, María Elena Schivo and María Rosa Romiti Calculus & GeoGebra an Interesting Partnership Procedia - Social and Behavioral Sciences 174 1183-1188 12 February 2015
[5] Gabriel Sosa Felipe. Transformaciones en el plano utilizando software de geometría dinámica. Revista de didáctica de las matemáticas, N. 75 (Noviembre), 2010 pgs. 43-70