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SFOPDES.dfw: A stepwise tutorial for solving Partial Differential Equations with DERIVE

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Partial Differential Equations (PDE) are one of the most difficult topics that Engineering and Sciences students have to study in the different Math subjects in their degree.

In this talk we introduce the library `SFOPDES.dfw` (Stepwise First Order Partial Differential Equations Solver) aimed to be used as a tutorial for helping both the teacher and the students in the teaching and learning process of PDE.

The type of problems that `SFOPDES.dfw` solves can be grouped in the following three blocks:

1. **Pfaff Differential Equations**, which consists on finding the general solution for:

$$P(x,y,z)\,\mathrm{d}x + Q(x,y,z)\,\mathrm{d}y + R(x,y,z)\,\mathrm{d}z = 0$$

   (a) General method.
   (b) Particular cases:
      i. Separable equations.
      ii. Exact Pfaff equations.
      iii. One-separated variable equations.

2. **Quasi-linear Partial Differential Equations**, which consists on finding the general solution for: $P(x,y,x)\,p + Q(x,y,z)\,q = R(x,y,z)$ where $p = \dfrac{\partial\, z}{\partial\, x}$ and $q = \dfrac{\partial\, z}{\partial\, y}$.

   (a) General method.
   (b) Particular solution which contents a given curve Γ.

3. Using **Lagrange-Charpit Method** for finding a *complete integral* for a given general first order partial differential equation: $F(x, y, z, p, q) = 0$.
   (a) General method.
   (b) Particular cases:
      i. $F(p, q) = 0$
      ii. $g_1(x, p) = g_2(y, q)$
      iii. $z = px + qy + g(p, q)$

In [1], a talk given at ACA 2018 conference, we introduced the first version of this tutorial where the general methods for each type of the above PDE were considered. In this talk we extend that work introducing new programs which solve the particular cases of Pfaff equations and general first order PDE using Lagrange-Charpit method.

We use the CAS DERIVE to develop this tutorial since the authors have a large background in developing tutorials for teaching different Math topics for Engineering students as can be seen in previous ACA conferences and in published papers as [2] or [3].

In addition, we are migrating this tutorial to a free and multi-platform environment as PYTHON programming language using SYMPY which is a CAS extension for PYTHON. This way, the tutorial will be available for any user without the need of a proprietary software as DERIVE. In this talk, we will also show the advances in this migration.

Keywords
PDE, Stepwise tutorial, CAS, DERIVE

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