## A Numerical Approach to Pfaffian Equations <u>Luís Bandeira<sup>1,2</sup></u> and Pablo Pedregal<sup>3</sup>

<sup>1</sup> Department of Mathematics, University of Évora, Portugal

<sup>2</sup> CIMA, University of Évora, Portugal

<sup>3</sup> Department of Mathematics, University of Castilla La Mancha, Spain

Corresponding/Presenting author: lmzb@uevora.pt

## Talk Abstract

Although being a part of a well-established classic area in Differential Geometry and Algebra, Pfaffian differential equations are somewhat unknown these days, at least in Analysis. Although formally formulated by Pfaff [3], the problem was already known to Euler [2]. From an analytical viewpoint, it has been traditionally treated in textbooks dealing with Differential Equations focusing on analytical techniques to understand and, eventually, find solutions. The success of those methods are however limited to explicit situations where computations can be carried out. There are some general existence and uniqueness results as well. Yet the numerical approximation of such solutions has not been, as far as we know, treated. By means of a variational approach based on a true vector variational problem, we propose a mechanism to examine and numerically approximate such solutions [1].

**Keywords:** differential equations, vector variational problems, conjugate gradient method.

## Acknowledgements

L. Bandeira was partially supported by CIMA, through Project UIDB/046-74/2020 of FCT–Fundação para a Ciência e a Tecnologia, Portugal. P. Pedregal was supported by grants PID2020–116207GB–I00, and SBPLY–19–180501–000110.

## References

- [1] L. Bandeira and P. Pedregal, Pfaffian equations: a variational perspective, to appear in *Differential and Integral Equations*
- [2] L. Euler, "Institutiones calculi differentialis" G. Kowalewski (ed.), Opera Omnia Ser. 1; opera mat., 10, Teubner (1980) pp. Chapt. IX ((in Latin)).

[3] J. F. Pfaff, Methodus generalis aequationes differentiarum partialium, nec non aequationes differentiates vulgares, utrasque primi ordinis, inter quoteunque variabiles, complete integrandi. Abhandl. Kgl. Akad. Wiss. Berlin, 1814-1815, S. 76-135.