# UNIVERSIDADE DE ÉVORA
## ESCOLA DE CIÊNCIAS E TECNOLOGIA
### DEPARTAMENTO DE MATEMÁTICA

**Centro de Investigação em Matemática e Aplicações**

**Departamento de Matemática**

**Programa de Doutoramento em Matemática**

## Seminário

**4 de dezembro de 2019**

**CLAV- Anf 4 -14h00**

## External numbers: a model for orders of magnitudes and imprecisions

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## Abstract

The *external numbers* are an attempt to model orders of magnitude as numbers, in relation to a nonstandard set of real numbers, rather than functions, which give the notation $O(.)$ and $o(.)$. The calculation rules are either equal to the rules for real numbers, or are adaptations. In particular each external number has its own zero, called *neutrix*. We present an axiomatic system for the external numbers, in analogy with the axioms for the real numbers, which we complete with an axiom that postulates the existence of a non-trivial neutrix. We build a structure satisfying all the axioms, called a *Complete Arithmetical Solid*, showing the consistency of the axiomatic system. We show how the structure captures the intrinsic imprecisions of orders of magnitudes, the Sorites paradox and informal error analysis. Some applications in error propagation and perturbation analysis are indicated.

### Acknowledgements

# References

[1] B. Dinis, I. P. van den Berg, Neutrices and External Numbers: A Flexible Number System (Chapman & Hall, London, 2019)

[2] J. Justino, I.P. van den Berg, Cramer's rule applied to flexible systems of linear equations, Electronic Journal of Linear Algebra, 24, 126–152 (2012), DOI: 10.13001/1081-3810.1584

[3] N. Van Tran, I.P.van den Berg, A parameter method for linear algebra and optimization with uncertainties, Optimization (2019), DOI: 10.1080/02331934.2019.1638387