

# Numerical ranges - theory and applications

Iwona Wróbel<sup>1,2</sup>

<sup>1</sup>*Warsaw University of Technology, Poland*

<sup>2</sup>*Institute of Mathematics, Polish Academy of Sciences*

## Abstract

The numerical range of a matrix  $A \in \mathbb{C}^{n \times n}$  (also known as the field of values or the Hausdorff set of a matrix) is defined in the following way  $W(A) = \{\langle Ax, x \rangle : x \in \mathbb{C}^n, \|x\| = 1\}$ .

There exist several generalizations of this notion, for example  $C$ -numerical range or rank- $k$  numerical range.

We will present a survey of their most interesting properties together with some applications, for instance in quantum information theory and physics.