



**UNIVERSITÀ  
DI TRENTO**  
Dipartimento di  
Matematica

# DOTTORATO



CYCLE 34th  
ORAL DEFENCE OF THE PHD THESIS

**Friday 28 October 2022 – at 10.30 am**  
Seminar Room “-1”

The event will take place in presence and online through the ZOOM platform.  
To get the access codes please contact the secretary office

## Ludovico Bruni Bruno

PhD Student in Mathematics

### Weights as degrees of freedom for high order Whitney finite elements

**Abstract:**

High order Whitney forms, also known as trimmed polynomial differential forms, are a celebrated family of differential forms. They find their roots in Hassler Whitney's book Geometric integration theory, published in 1957, where a low degree counterpart was used to prove the famous de Rham's Theorem. It was only in the '80s that they were recognised as a powerful tool in numerical analysis, when they were proved to parametrise Nédélec's first family of finite elements. In Whitney's spirit, one may choose weights, namely integrals of  $k$ -forms on  $k$ -simplices, as degrees of freedom for these spaces. To do this, the concept of small simplices shall be introduced. A small simplex is a piece of a (virtual) partitioning of a simplex. We show that weights associated with appropriate small simplices ensure unisolvence for Nédélec's first family and we offer a strategy to shape the geometry of small simplices. This allows to generalise classical concepts peculiar to Lagrangian finite elements and Lagrangian interpolation to higher dimensional frameworks. We first develop the corresponding theory and then offer numerical examples, relating results with the geometry of the problem.

**Supervisors:**

Ana María Alonso Rodríguez (University of Trento)  
Francesca Rapetti Gabellini (Université Cote d'Azur)

**CONTATTI**

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