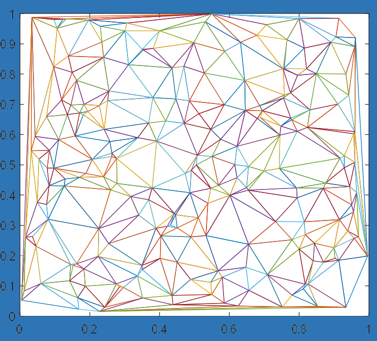
Department of Mathematics “Giuseppe Peano”
University of Turin

Erasmus+ Incoming Teaching Staff

COURSE SCHEDULE
Academic Year 2021/2022

SHARP APPROXIMATIONS BASED ON DELAUNAY TRIANGULATIONS AND VORONOI DIAGRAMS

Lecturer: Prof. Allal Guessab
Laboratory of Mathematics and its Applications of PAU
University of Pau and Adour Region, France

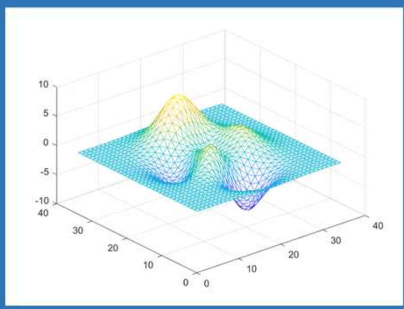


CLASS SCHEDULE

ROOM LAGRANGE

FRI 17/06 09.00 – 13.00
TUE 21/06 14.00 – 18.00
THU 23/06 09.00 – 13.00
TUE 28/06 09.00 – 13.00

https://unito.webex.com/meet/allal.guessab



On these lectures, we first present the concepts of a Voronoi diagram and of a Delaunay triangulation. These two geometrical structures are important tools in many areas like Astronomy, Physics, Chemistry, Biology, Ecology, Economics, Mathematics and Computer Science. Here, we present a set of results showing some of the advantages of their optimality criteria in computing integral approximations, which are based upon a geometric point of view exploiting Delaunay triangulations and Voronoi tessellations.

We begin by introducing a new class of cubature formulas for numerical integration (or multidimensional quadrature), that approximate from above (or respectively from below) the exact value of the integrals of every function having a certain type of convexity.

Under suitable regularity assumptions, we show that all these integral approximations enjoy certain desirable properties. In particular, they can be totally characterized in terms of the approximation error generated by a multidimensional quadratic function.

We show that the Delaunay triangulation, the Voronoi tessellation and their generalizations give access to efficient algorithms for computing these cubature formulas.

We will combine theoretical results from polytope domain meshing, these (extended) new multidimensional integration formulas, generalized barycentric coordinates, and finite element exterior calculus to construct scalar- and vector-valued basis functions for conforming and nonconforming polytope finite element methods on generic convex polytope meshes in any dimension.

Finally, our last objective is to check the effectiveness of our approach to construct new enriched nonconforming polytope finite elements, and to show, for a specific problem, how the enlargement of the range of choice of the enrichment functions can help to improve some convergence properties, even if we choose to enrich with non-polynomials functions.

We also briefly discuss some ongoing related research, and summarizes the major parts of my current research related to this topic.

Contacts: roberto.cavoretto@unito.it, alessandra.derossi@unito.it