Solving challenging problems using GeoGebra … at a distance

Corrado Falcolini[a]

[a]*Roma Tre University, Via della Madonna dei Monti 40, Rome 00184, Italy*

Abstract: Convergence in education can be seen as a way to teach a subject by integrating knowledge, methods, and expertise from different disciplines for scientific discovery and innovation. The use of problem solving, inspired by computer aided algorithms and visualization, has become a common example of convergence in geometry and its applications. As an example, we pose several mathematical problems and indicate possible solution processes using GeoGebra. The use of numeric or symbolic calculus and interactive geometric software provide approximate, exact or graphical solutions allowing to go back to the abstract nature of the problem, generalizing it and posing new questions.

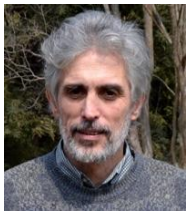
Themes range from the approximation of π to solid sections, from Penrose tessellations to Escher's Circle Limit and hyperbolic geometry; problems can be very general, well or ill posed, direct or inverse, global or local.

For example, find a family of cones sharing the same XY plane section. What is the minimum value of n so that P_n, a regular polygon with n sides, it is not distinguishable from a circle? What is the minimum number n so that the ratio between the perimeter of P_n and the diameter of the circumscribed circle is at least 3.14? How many different types of regular cube sections are there? How to make the tiles of an aperiodic tessellation using a numerical cutting machine? Which kind of symmetry guided some of Escher's work?

When the problems are challenging, they are also suitable to be organized in cooperative or distance learning. Most of these subjects have been used in a course for future teachers even in this Covid year.

Keywords: GeoGebra software, Penrose aperiodic tessellation, problem solving, visualization

---



Corrado Falcolini is Associate Professor in Mathematical Physics at the Department of Architecture of Roma Tre University. His research interests include stability in Hamiltonian systems, analytical properties of maps, history and innovation in mathematical teaching, modelling 3D surveys. Curator of several exhibits at Genova Science Festival and Rome Mathematics Festival with the laboratory www.formulas.it. Member of the national Scientific Degree Plan and local Mathematical Olympiad for high school students and their teachers.