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English summaries

Jaume Aguadé

A review of rotations in low dimensions

We begin by discussing rotations in linear geometry and orthogonal matrices, and go on to present explicit, elementary and self-contained constructions of the classical isomorphisms between spinor groups in dimensions < 7 and certain unitary or symplectic groups. The paper is intended to serve as lecture notes for an introductory course on compact Lie groups.

Keywords: rotation, spinor, Lie group, quaternions.

MSC2020 Subject Classification: 22-01, 20G20, 22E15.

Jaume Coll Guerrero

Polyhedra and modular origami

This paper presents modular origami techniques that allow us to create a wide variety of polyhedra from paper: the five Platonic solids, the thirteen Archimedean polyhedra, the eight convex deltahedra and their stellations, prisms, antiprisms, pyramids and Fullerian geodesic domes, among others.

Keywords: modular origami, polyhedra, Platonic solids, Archimedean polyhedra, origami techniques, tessellations.

MSC2020 Subject Classification: 00A08, 00A66, 05B45, 51M20, 52B05, 52B10.

Xavier Guitart and Marc Masdeu

Rational points on elliptic curves

Elliptic curves are currently among the most extensively studied objects in number theory. They can be described by cubic equations in two variables, but what sets them apart – and makes them fascinating – is the rich algebraic structure exhibited by their solutions. The aim of this article is to explain what elliptic curves are and to explore their most significant properties, some of which rank among the most important results in 20th- and 21st-century mathematics. We will also discuss several open conjectures that continue to shape current research. To place elliptic curves within a broader historical and conceptual context, we present them as a specific class of Diophantine equations – a recurrent and central theme in number theory.

Keywords: Diophantine equations, elliptic curves, Heegner points, p-adic integration, Stark-Heegner points.

MSC2020 Subject Classification: 14H52, 11G05.

Jaume de Haro

The Friedmann equations: Newtonian mechanics vs. general relativity

In this paper, we present a heuristic derivation of the perturbed Friedmann equations based on Newtonian mechanics, offering an intuitive perspective on these cosmological relations. This approach highlights the remarkable agreement between Newtonian and relativistic descriptions within certain limits, serving both as a conceptual – and even philosophical – bridge, and as a pedagogical tool to deepen understanding of the physical principles governing the evolution of the universe. By simplifying the complex mathematical framework of general relativity, this method provides an accessible means of exploring the dynamics of the universe. It underscores how classical mechanics, when applied carefully, can offer insights that align with relativistic results in the linear approximation. This connection not only enhances our understanding of the universality of physical laws but also reinforces the idea that relativistic phenomena can often be interpreted through familiar classical analogues.

Keywords: Friedmann equations, cosmological perturbations, Newtonian mechanics, general relativity.

MSC2020 Subject Classification: 83C05, 83C99, 70F99, 83F05.

Luis Sierra, Marta Casanellas and Piotr Zwiernik

Tensors in algebraic statistics

Tensors are ubiquitous in statistics and data analysis. The central object that links data science to tensor theory and algebra is that of a model with latent variables. We provide an overview of tensor theory, with particular emphasis on its applications in algebraic statistics. This high-level overview is accompanied by numerous examples to illustrate key concepts. Additionally, an extensive literature review is included to guide readers towards more detailed studies on the subject.

Keywords: tensors, algebraic statistics, graphical models, tensor decomposition.

MSC2020 Subject Classification: 14M99, 15A69, 62H22, 62R01, 62R07.