

# Preface

The demand for more reliable geometric computing in mathematical, physical and computer sciences has revitalized many venerable algebraic subjects in mathematics, and among them, there are Grassmann-Cayley algebra and Geometric Algebra. As distinguished invariant languages for projective, Euclidean, and other classical geometries, the two algebras nowadays have important applications not only in mathematics and physics, but in a variety of areas in computer science such as computer vision, computer graphics and robotics.

This book contains the author and his collaborators' most recent, original development of Grassmann-Cayley algebra and Geometric Algebra and their applications in automated reasoning of classical geometries. It includes the first two of the three advanced invariant algebras: Cayley bracket algebra, conformal geometric algebra, and null bracket algebra, together with their symbolic manipulations, and applications in geometric theorem proving.

The new aspects and mechanisms in integrating the representational simplicity of the advanced invariant algebras with their powerful computational capabilities, form the new theory of classical advanced invariants. It captures the intrinsic beauty of geometric languages and geometric computing, and leads to amazing simplification in algebraic manipulations, in sharp contrast to approaches based on coordinates and basic invariants.

As a treatise offering a detailed and rigorous mathematical exposition of these notions, at the same time offering numerous examples and algorithms that can be implemented in computer algebra systems, this book is meant for both mathematicians and practitioners in invariant algebras and geometric reasoning, for both seasoned professionals and inexperienced readers. It can also be used as a reference book by graduate and undergraduate students in their study of discrete and computational geometry, computer algebra, and other related courses. For the first-time reading, those sections marked with asterisks are suggested to be skipped by beginners.

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