Special Issue Algebraic Coding Theory and Applications

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This issue of the Journal of Symbolic Computation is a follow-up to the "Soria Summer School on Computational Mathematics: Algebraic Coding Theory" supported by the group SINGACOM of the University of Valladolid, held at the Campus Duques de Soria of the University of Valladolid in Soria, July 2-11, 2008 and the Special Session "Computer Algebra and Coding Theory 2008", hosted at ACA 2008 held at the RISC Institute of the Johannes Kepler University in Hagenberg, Austria, July 27-30, 2008.

This special issue includes a selection of research articles applying symbolic and computational techniques from various fields (algebra, combinatorics, etc.) to the field of coding theory. Error correcting codes are important from both a mathematical-theoretical point of view and in practical applications: their study involves computer algebra and symbolic computation, linking algorithmic and abstract algebra to methods of computer science,

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while at the same time being an identifiable branch of communication theory. As a result there is a mutual interest in coding theory from a variety of disciplines, both in theory and practice, and there are many examples of applications which are intertwined across several of these fields. In this special issue we have included contributions to several aspects of the theory and applications, grouped into two categories: (i) Applications of the methods of algebraic geometry to coding theory, (ii) Combinatorial constructions of codes.

In *The Weight Distributions of Cyclic Codes with Two Zeros and Zeta Functions*, Nigel Boston and Gary McGuire study the weight distribution of the binary cyclic code of length $2^n - 1$ with two zeros. The proof gives information in terms of the zeta function of an associated variety. As an interesting application of the method they prove that any two such codes of a given odd length have the same weight distribution.

The paper *AG Codes from Polyhedral Divisors*, by Nathan Owen Ilten and Hendrik Süß, displays the use divisors on $T-$varieties to define new evaluation codes called $T-$codes. The authors find estimates on the minimum distance of these codes using intersection theory. As a first application of these techniques they look at codes on ruled surfaces coming from decomposable vector bundles. Already this construction gives codes that are better than the related product codes. Further examples show that they can improve these codes by constructing more sophisticated varieties.

The paper *Decoding by rank-2 bundles over plane quartics*, by Drue Coles and Emma Previato, poses some hard questions regarding moduli spaces of rank-2 vector bundles over algebraic curves. The authors propose a new approach to these questions related to the restriction of vector bundles from the projective space where the curve is embedded. They specialize the analysis to plane quartic curves and, in that case, they work out explicit equations for the error divisors viewed as points of a multisecant variety.

In *Key equations for Guruswami–Sudan list decoding of Reed–Solomon codes and how to solve them*, the authors, Peter Beelen and Kristian Brander, obtain an algorithm for the interpolation step of the Guruswami-Sudan list decoding algorithm for Reed-Solomon codes which has complexity $O(sl^4 n \log^2 n \log\log n)$ where l is the designed list size and s the multiplicity parameter.

We then have two papers are related to combinatorial constructions of codes.

In *Binary codes from the line graph of the n-cube*, W. Fish, J.D. Key and E. Mwambene examine designs and binary codes associated with the line graph of the n-cube. They describe the automorphism groups and the parameters of the codes. Also they find a regular subgroup of the automorphism group that can be used for permutation decoding.

Finally, the paper *Quotients of Gaussian Graphs and their Application to Perfect Codes*, by C. Martínez, R. Beivide, C. Camarero, E. Staord and E. M. Gabidulin presents a graph-based model of perfect two-dimensional codes which facilitates the study of their metric properties. This makes it possible to apply previously known properties to the analysis of perfect codes. To illustrate the power of this graph-based tool, perfect Lee codes are analyzed in terms of Gaussian graphs and their quotients.

We received many more papers than we could include and we thank the authors of all the papers submitted. Becasue of the high quality of the submissions, the process of deciding which papers to include was not easy and we are very grateful to the referees for their assistance in helping us reach our final selection.