AUTOMORPHISM GROUPS OF GEOMETRIC CODES

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Abstract

The aim of this thesis is to study geometric codes over algebraic curves and their automorphism groups. In particular, we are interested in the relation between the automorphism group of the code and the automorphism group of the curve from which it originates.

The first problem we study concerns algebraic codes viewed as ideals in group algebras (Chapter 4). We prove that when the automorphism group of the curve acts regularly on a subset of the points then codes can be constructed which are ideals in the group algebra of the automorphism group over the corresponding field. We also show how this can be useful in decoding.

In 1980 Goppa conjectured that the only automorphisms of a geometric codes were the ones originating from the underlying algebraic curve. Ten years later Stichtenoth studied this situation and proved that Goppa's conjecture was true when the algebraic curve is the projective line. In the general case the automorphism group of the curve forms a subgroup of the full automorphism group of the code and often the two groups are indeed different.

We have studied in detail two classes of algebraic codes: elliptic codes (Chapter 5) and hyperelliptic codes (Chapter 6 and Chapter 7).

The choice of elliptic curves and elliptic codes comes from the fact that the structure of elliptic curves is well-known. This allows us to find out more about the geometric codes constructed on these curves. We investigate many examples and obtain results on MDS codes. More precisely, we prove that there are no MDS codes coming from elliptic curves with an odd number of points over fields of even characteristic. We also find several codes which are ideals in group algebras of automorphism groups of the curve over the given field.

Hyperelliptic curves look like the natural generalization of elliptic curves and therefore we decided to study hyperelliptic codes. Unfortunately much less is known about these curves. We examine the case when the ground field is of even characteristic, and the curve has equation $y^2 + y = f(x)$. We first prove that the genus of such a curve is $(n-1)/2$ where n is the degree of $f(x)$ and n is even.

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