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Effective construction of Riemann-Roch spaces in global function fields

Let F/k be a global function field, that is, a field F of transcendence degree one over a finite field k. The set of all places of F is denoted by $\mathbb{P}_F$. Given a divisor $D = \sum_{\mathfrak{p}\in\mathbb{P}_F} n_\mathfrak{p}\mathfrak{p}$ the Riemann-Roch space of D is defined to be

$$\mathcal{L}(D) = \{\alpha \in F \mid \nu_\mathfrak{p}(\alpha) \geq -n_\mathfrak{p} \text{ for all } \mathfrak{p} \in \mathbb{P}_F\}.$$

It is a finite dimensional vector space over k. Let now F/k explicitly be given by an equation $f(x, y) = 0$ with an irreducible, in y separable and monic polynomial $f \in k[x, y]$ (which is always possible). In this contribution an effective algorithm for the construction of a basis of $\mathcal{L}(D)$ using the above representation of F is presented. There are many interesting applications, for example the construction of algebraic geometric codes.