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Units in Cubic Function Fields

An efficient algorithm for computing the fundamental unit, or equivalently, the regulator, of a real quadratic field has so far eluded researchers. Similarly, finding the the fundamental unit(s) of a cubic field remains computationally hard for large field sizes, and the task only becomes messier as the degree of the field extension increases. Interestingly, both the quadratic and the cubic scenario employ different variants of the simple continued fraction algorithm to generate the fundamental unit(s).

The task at hand seems to be just as hard for function fields. The best known methods here are basically extensions of the number field methods, but there are subtle differences which we will explain. In this talk, we focus mainly on unit computation in cubic function fields. We explain how to determine the unit rank of such an extension and how to find a system of fundamental units using an extension of Voronoi's algorithm. One of the main obstacles to efficient unit computation is the huge size of the fundamental units—they are generally exponential in the size of the field—so as a matter of curiosity, we also provide parameterized families of purely cubic function fields with unusually small fundamental units.