Computing integral bases via localization and Hensel lifting.

Summary: We present a new algorithm for computing integral bases in algebraic function fields of one variable, or equivalently for constructing the normalization of a plane curve. Our basic strategy makes use of the concepts of localization and completion, together with the Chinese remainder theorem, to reduce the problem to the task of finding integral bases for the branches of each singularity of the curve. To solve the latter task, in turn, we work with suitably truncated Puiseux expansions. In contrast to van Hoeij's algorithm (van Hoeij, 1994), which also relies on Puiseux expansions (but pursues a different strategy), we use Hensel's lemma as a key ingredient. This allows us at some steps of the algorithm to compute factors corresponding to conjugacy classes of Puiseux expansions, without actually computing the individual expansions. In this way, we make substantially less use of the Newton-Puiseux algorithm. In addition, our algorithm is inherently parallel. As a result, it outperforms in most cases any other algorithm known to us by far. Typical applications are the computation of adjoint ideals and, based on this, the computation of Riemann-Roch spaces and the parametrization of rational curves.

MSC:
13-XX Commutative algebra
14-XX Algebraic geometry
68W30 Symbolic computation and algebraic computation

Keywords:
normalization; integral closure; integral basis; curve singularity; Puiseux series

Software:
Maple; Magma; SINGULAR

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References:


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