Numerical groebner

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1 Numerical groebner

The task on numerical groebner consists in an implementation and a preliminary report on experimentation. The PoSSoLib-2.1.1 contains the implementation described here.

The implementation consists in:

- a series of customizations of Buchberger algorithm adequate to handle computations with coefficients being floating numbers;
- implementations of floating numbers as PL_Coeff, with all the features needed for the use of a customized Buchberger algorithm.

As customization of algorithms, we provided:

- several customization functions for Buchberger algorithm:
  - customization of BasisInsert: BasisAppendForHybrids;
  - customization for InternalNormalize: CleanInfinitesimal;
  - customization for interrupting without aborting it: BreakNow (customization of IsToBreak)
  - customization for SelectionStrategy: TCWeightSaltStrategy;
- a new customization of tangent cone algorithm, Badness, that can be specialized to ecart or to salt (this latter being higher when a polynomial is worse as pivot).

The features needed for floating coefficients are:

- an integer function logSize, used in the definition of salt;
- a comparison function isInfinitesimal, used in the numerical strategies.

The salt is defined, for a polynomial, as the difference between the max logSize of a trailing coefficient and the logSize of the leading coefficient, and expresses how bad is a polynomial for pivoting.

Up to now, the customized floats are Hybrids, based on gmp, and DHybrids, based on DPE. We expect to provide further coefficients: intervals, hybrid intervals, pairs of bigfloats with different size. These will be useful in further experiments.

To perform a groebner basis computation with floating coefficients the user has to customize the GroebnerReductor with adequate functions. We will provide a reasonable default, different from the default for exact coefficients, but experiments are needed to find the best choice.

Some experiments have been conducted to find the better tuning of the algorithms, but the experiments are still in course.

A first report [1], in the form of extended abstract, has been submitted to the CASC98 conference (Computer Algebra in Scientific Computing), and is an annex to the full report.

We expect to implement further customizations of Buchberger algorithm, tangent cone and involutive algorithm, and to report on the experiments in the final form of the submission to CASC98. The findings will be included in the final report on numerical groebner.

2 Strategies

The work on strategies has concentrated on numerical strategies, and is hence included in 3.3.1.3.

References

[1] C. Bonini, K-P. Nischke, C. Traverso, Computing Gröbner bases numerically: some experiments, submitted to CASC98 (1998).