Efficient rational creative telescoping

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Abstract: Since 1990s, creative telescoping has become the cornerstone for evaluating definite sums of discrete special functions in computer algebra. Various algorithmic generalizations and improvements for this technique have been developed over the past two decades. At the present time, the reduction-based approach has gained the most support as it is both efficient in practice and has the important feature of being flexible to find a telescoper for a given function with or without construction of a certificate. There is, however, one handicap of this approach. That is, the approach can suffer from intermediate expression swell, especially in the part of a certificate, even if the final output ends up to be small.

In this talk, we present a new algorithm to compute minimal telescopers for rational functions in two discrete variables. This is the first step towards the long-term goal of developing fast creative telescoping algorithms for special functions that circumvent intermediate expression swell. As with the reduction-based approach, our algorithm also has the nice feature that the computation of a telescoper is independent of its certificate. Moreover, our algorithm uses a sparse representation of the certificate, which allows to be more easily manipulated and analyzed without knowing the precise expanded form. This sparse representation hides any potential exponential expression swell until the final (and optional) expansion. A complexity analysis, along with a Maple implementation, suggests that our algorithm has better theoretical and practical performances than the reduction-based approach when restricted to the rational case. This is joint work with M. Giesbrecht, G. Labahn and E. Zima.