Computer Algebraic Analysis: Achievements, Perspectives and Directions

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Computer Algebraic Analysis widely uses tools from ring and module theory, from homological algebra and from dimension theory by particularly emphasizing the algorithmic component of the computations and the role of implementation of algorithms in computer algebra systems. In the realm of systems of linear partial functional operators with polynomial coefficients, Gel'fand-Kirillov dimension, Ore localization with associated torsion and closure, and decomposition of modules such as equidimensional filtration and a decomposition, arising from the generalized factorizing Gröbner algorithm find numerous applications. On the other hand, many special functions, appearing as modules over mentioned algebras of operators, can be viewed as representation of modules in certain functional spaces.

The description of special functions in [1] is given over algebras of operators with rational coefficients in the arguments. We recognize those algebras as Ore localizations of algebras with polynomial coefficients and aim at the *augmented* description of special functions (obtained with the tools, described above), which is valid in a much broader context.

In the talks by J. Hoffmann, N. Kruff, J. Nüßle, C. Schilli (RWTH Aachen, Germany) and A. Heinle (University of Waterloo, Canada) many particular topics of the presented program and implementations in SINGULAR:PLURAL [2] will be discussed in details. In my talk I will outline the state of the art, summarize and present open questions.

References

[1] Milton Abramowitz and Irene Ann Stegun: *Handbook of Mathematical Functions*, `http://dlmf.nist.gov`.

[2] Greuel, G.-M. and Levandovskyy, V. and Motsak, A. and Schönemann, H., PLURAL. *A* SINGULAR *4.0 Subsystem for Computations with Non-commutative Polynomial Algebras*. Centre for Computer Algebra, TU Kaiserslautern, (2016). `http://www.singular.uni-kl.de`