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# Lukas Einkemmer (talk 7): Higher-order dynamical low-rank methods

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Dynamical low-rank algorithms have developed into an efficient way to solve high-dimensional problems ranging from plasma physics to quantum mechanics. Those methods are attractive because they reduce a high-dimensional problem into a set of lower-dimensional equations and can thus overcome the curse of dimensionality. This, for example, enables 6D Vlasov simulation on a desktop computer that otherwise would require large supercomputers. Mathematically, dynamical low-rank methods project the true dynamics onto a low-rank manifold (the approximation space). The most common approach to do this robustly is the projector splitting integrator. While composition can be used to raise this to second or higher order, there is currently no rigorous proof available that shows that the resulting scheme is second-order accurate (although this is usually observed in numerical experiments). More recently, a class of so-called (augmented) basis update & Galerkin (BUG) schemes have been introduced. These are, for example, commonly used as the building block for structure-preserving dynamical low-rank schemes. However, the literature on such methods has focused on first-order and explicit methods. In this talk, we present our recent work that allows the construction of higher-order BUG type integrators. In particular, we will show that these integrators are provably second-order accurate. We also show that implicit variants of such methods can be constructed, which e.g. for step and truncate type low-rank algorithms is much more difficult. The resulting implicit schemes have the added benefit that the linear systems that need to be solved are much smaller than for the original problem, while still maintaining desirable properties such as unconditional stability.