Model Order Reduction for Maxwell Equations based on Moment Matching

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The numerical simulation of electromagnetic fields is a frequent and time-consuming task in many applications. The behavior of electromagnetic fields is typically described by the time-domain Maxwell equations of first order. These lead to large-scale time-dependent partial differential equations in three spatial dimensions. Often one is only interested in the input-output properties of this system, particularly in computational nano electronics. One approach to deal with these large-scale systems consists of model order reduction methods, in particular when the equations have to be solved many times with different inputs. After semi-discretization with respect to the spatial variables, usually a subspace of much smaller order is generated to replace the original system by a reduced order model that inherits the major properties of the original model.

We will present an algebraic approach for solving Maxwell equations, which will be two-fold. On one hand we will present model order reduction methods based on moment-matching methods. These will make use of rational Arnoldi-type methods (AORA) and an adaptive expansion point selection to generate a subspace for the reduced-order model. Besides, structure-preserving aspects with respect to the original model are taken into account. On the other hand, we will discuss methods for raising the efficiency of the numerical algorithms by recycling. Here, subspaces from a previous call of the rational Arnoldi method can be re-used. Furthermore, solving sequences of of shifted systems with slightly varying shifts and varying right hand sides allow for preconditioned Krylov subspace methods with subspace recycling.

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