Abstract. Computational scientists often encounter problems requiring the solution to large sparse systems. To enable fast and accurate simulations, the execution time of these solvers needs to be accelerated on modern high-performance architectures. In this talk, I will show that through mathematical reformulation and algorithm re-engineering, memory access patterns in iterative sparse solvers can be restructured to significantly improve their performance on parallel architectures. I will also discuss our recent advances in building domain-specific compilers for sparse matrix computations to automatically generate fast code for sparse numerical methods.