

Marc Alexander Schweitzer



Academic career

2002	Dr. rer. nat., University of Bonn
2010 - 2013	Professor (W3), University of Stuttgart
Since 2013	Professor (W3), University of Bonn, and Fraunhofer SCAI, Sankt Augustin

Honours

1999	Second Prize SuParCup, Mannheim, Germany
2003	Second Prize Leslie Fox Prize, Cambridge, England, UK

Research Projects and Activities

High-Performance Parallel Computing
Parallel Algebraic Multigrid
Parallel Partition of Unity Methods

Research profile

The development of efficient meshfree methods for partial differential equations is at the center of my research work. Since these modern methods do not require the availability of an appropriate computational mesh they alleviate the treatment of applications in complex domains, especially in time-dependent settings.

The particle-partition of unity method, a meshfree generalization of the finite element method I have developed together with Prof. Dr. M. Griebel, furthermore allows for the easy incorporation of a priori information about special local behavior of the solution (e.g. discontinuities and singularities) by so-called enrichment. If such information is available (analytically or numerically) this enrichment technique reduces the computational complexity substantially since it eliminates the need for classical adaptive refinement. This enrichment technique can also be interpreted as a multiscale coupling.

In fracture mechanics for instance good enrichment information is often available from asymptotic expansions of the solution. Hence, the use of enriched approximation techniques is becoming well-established in this field. In general however the numerical construction of appropriate enrichment information is necessary. Here, the use of adaptive refinement or microscale simulations must be employed. The automatic computation of fine scale enrichment information and its incorporation in a coarse scale simulation is a very important research topic with wide application and thus shall be further explored also in the future.

Research Area J We focus on the development of multi scale generalized finite element methods / multi scale partition of unity methods.

Selected publications

- [1] P. Diehl and M. A. Schweitzer. Efficient neighbor search for particle methods on gpus. In M. Griebel and M. A. Schweitzer, editors, *Meshfree Methods for Partial Differential Equations VII*, volume 100 of *Lecture Notes in Computational Science and Engineering*. Springer, 2015. Also available as INS Preprint No. 1405.
- [2] M. A. Schweitzer and S. Wu. Numerical integration of on-the-fly-computed enrichment functions in the pum. In M. Griebel and M. A. Schweitzer, editors, *Meshfree Methods for Partial Differential Equations VII*, volume 100 of *Lecture Notes in Computational Science and Engineering*. Springer, 2015. Also available as INS Preprint No. 1406.
- [3] M. A. Schweitzer and A. Ziegenhagel. Dispersion properties of the partition of unity method & explicit dynamics. In M. Griebel and M. A. Schweitzer, editors, *Meshfree Methods for Partial Differential Equations VII*, volume 100 of *Lecture Notes in Computational Science and Engineering*. Springer, 2015. Also available as INS Preprint No. 1407.
- [4] M. Schweitzer. Variational mass lumping in the partition of unity method. *SIAM Journal on Scientific Computing*, 35(2):A1073–A1097, 2013.

- [5] M. A. Schweitzer. Multilevel partition of unity method for elliptic problems with strongly discontinuous coefficients. In M. Griebel and M. A. Schweitzer, editors, *Meshfree Methods for Partial Differential Equations VI*, volume 89 of *Lecture Notes in Computational Science and Engineering*, pages 93–110. Springer, 2013.
- [6] Marc Alexander Schweitzer. Generalizations of the finite element method. *Central European Journal of Mathematics*, 10:3–24, 2012.
- [7] M. A. Schweitzer. Multilevel particle–partition of unity method. *Numer. Math.*, 118:307–328, 2011.
- [8] M. A. Schweitzer. Stable enrichment and local preconditioning in the particle–partition of unity method. *Numer. Math.*, 118(1):137–170, 2011.
- [9] R. Croce, M. Griebel, and M. A. Schweitzer. Numerical simulation of bubble and droplet-deformation by a level set approach with surface tension in three dimensions. *International Journal for Numerical Methods in Fluids*, 62(9):963–993, 2009. Also available as SFB 611 Preprint no 431.
- [10] M. A. Schweitzer. An algebraic treatment of essential boundary conditions in the particle–partition of unity method. *SIAM Journal on Scientific Computing*, 31(2):1581–1602, 2009.
- [11] M.A. Schweitzer. An adaptive hp-version of the multilevel particle–partition of unity method. *Comput. Methods Appl. Mech. Engrg.*, 198:1260–1272, 2009.
- [12] M. Griebel, K. Scherer, and M. A. Schweitzer. Robust norm equivalencies for diffusion problems. *Math. Comput.*, 76:1141–1161, 2007.
- [13] M. Griebel, B. Metsch, D. Oeltz, and M. A. Schweitzer. Coarse grid classification: A parallel coarsening scheme for algebraic multigrid methods. *Numerical Linear Algebra with Applications*, 13(2–3):193–214, 2006. Also available as SFB 611 preprint No. 225, Universität Bonn, 2005.
- [14] U. Clarenz, M. Griebel, M. Rumpf, M. Schweitzer, and A. Telea. Feature sensitive multiscale editing on surfaces. *The Visual Computer*, (20):329–343, 2004. Also as Preprint No. erb= =89, SFB 611, Universität Bonn, Germany.
- [15] M. Griebel, D. Oeltz, and M. A. Schweitzer. An algebraic multigrid method for linear elasticity. *SIAM Journal on Scientific Computing*, 25(2):385–407, 2003.
- [16] M. A. Schweitzer. *A Parallel Multilevel Partition of Unity Method for Elliptic Partial Differential Equations*, volume 29 of *Lecture Notes in Computational Science and Engineering*. Springer, 2003.
- [17] M. Griebel and M. A. Schweitzer. A particle-partition of unity method—part ii: Efficient cover construction and reliable integration. *SIAM Journal on Scientific Computing*, 23(5):1655–1682, 2002.
- [18] M. Griebel and M. A. Schweitzer. A particle-partition of unity method—part iii: A multilevel solver. *SIAM Journal on Scientific Computing*, 24(2):377–409, 2002.
- [19] M. Griebel and M. A. Schweitzer. A particle-partition of unity method for the solution of elliptic, parabolic and hyperbolic pde. *SIAM Journal on Scientific Computing*, 22(3):853–890, 2000.