

## On the DPG method for Signorini problems <sup>\*</sup>

THOMAS FÜHRER<sup>†</sup>   NORBERT HEUER<sup>‡</sup>   ERNST P. STEPHAN<sup>§</sup>

### Abstract

We derive and analyze discontinuous Petrov-Galerkin methods with optimal test functions for Signorini-type problems as a prototype of a variational inequality of the first kind. We present different symmetric and non-symmetric formulations where optimal test functions are only used for the PDE part of the problem, not the boundary conditions. For the symmetric case and lowest order approximations, we provide a simple a posteriori error estimate. In a second part, we apply our technique to the singularly perturbed case of reaction dominated diffusion. Numerical results show the performance of our method and, in particular, its robustness in the singularly perturbed case.

**Key words:** contact problem, Signorini problem, variational inequality, DPG method, optimal test functions, ultra-weak formulation, reaction-dominated diffusion

**Mathematics subject classifications (1991):** 65N30, 65N12, 35J86, 74M15

### References

- [1] T. FÜHRER, M. KARKULIK AND N. HEUER, *On the coupling of DPG and BEM*. Math. Comp. (2016), appeared online, doi:10.1090/mcom/3170.
- [2] T. FÜHRER, N. HEUER AND E.P. STEPHAN, *On the DPG method for Signorini problems*. arXiv.org (2016), no. arXiv:1609.00765.
- [3] M. KARKULIK AND N. HEUER, *A robust DPG method for singularly perturbed reaction-diffusion problems*. SIAM J. Numer. Anal., to appear (2017).

---

<sup>\*</sup>This work was partially supported by CONICYT through FONDECYT projects 1150056 and 3150012

<sup>†</sup>Facultad de Matemáticas, Pontificia Universidad Católica de Chile, Santiago, Chile email: tofuehrer@mat.uc.cl.

<sup>‡</sup>Facultad de Matemáticas, Pontificia Universidad Católica de Chile, Santiago, Chile email: nheuer@mat.uc.cl

<sup>§</sup>Institut für Angewandte Mathematik, Leibniz Universität Hannover, Hannover, Germany, email: stephan@ifam.uni-hannover.