VALPARAISO NUMERICO IV
Séptimo Encuentro de Análisis Numérico de Ecuaciones Diferenciales Parciales
Facultad de Ingeniería, Pontificia Universidad Católica de Valparaíso, Diciembre 11–13, 2013

On the use of second order information for the numerical solution of PDE-constrained optimization problems with sparsity *

Juan Carlos De los Reyes[†] Estefana Loayza[‡] Pedro Merino[§]

Abstract

We present a family of algorithms for the numerical solution of PDE-constrained optimization problems, which involves an L^1-term in the objective functional. It is well known that this non-differentiable term leads to a sparse structure of the optimal control, which acts on "small" regions on the domain. In order to cope with the non-differentiability, we consider a Huber regularization of the L^1-term, which approximates the original problem by a family of parameterized differentiable problems. The general scheme of our algorithms is based on the BFGS algorithm to approximate the regular part of the cost functional. The main idea of our method is to compute descent directions by incorporating second order information. Subsequently, an orthantwise-direction strategy is used in the spirit of OW-algorithms in order to obtain a fast identification of the active sets. We present several experiments to illustrate the efficiency of our numerical algorithm.

Key words: PDE-constrained optimization, Sparsity, Second order methods.

Mathematics subject classifications (1991): 65N30, 65N12, 65N15, 74F10, 74B05, 35J05

References

[1] Gao J. Andrew G. Scalable training of l1-regularized log-linear models. *In Proceedings of the Twenty Fourth Conference on Machine Learning (ICML)*, 2007.

[2] Chin G. Nocedal J. Wu Y. Byrd, R. Sample size selection in optimization methods for machine learning. *Mathematical Programming*, 134(1), 2011.

*This research was partially supported by Senescyt-Ecuador

[†]**ModeMat** and Departamento de Matemática, EPN-Quito, e-mail: juan.delosreyes@epn.edu.ec
[‡]**ModeMat** and Departamento de Matemática, EPN-Quito
[§]**ModeMat** and Departamento de Matemática, EPN-Quito, e-mail: pedro.merino@epn.edu.ec

[3] Gonzio J. Fountoulakis, K. A second-order method for strongly convex ℓ_1-regularization problems. *arXiv*, (1306.5386v3), 2013.

[4] J. Nocedal and S. J. Wright. *Numerical Optimization*. Springer-Verlag, New York, 1999.

[5] Georg Stadler. Elliptic optimal control problems with L^1-control cost and applications for the placement of control devices. *Comput. Optim. Appl.*, 44(2):159–181, 2009.

[6] Chang K. Hsieh C. Lin C. Yuan, G. A comparison of optimization methods and software for large-scale l1-regularized classification. *Journal of Machine Learning Research*, (11):3183–3234, 2010.