Adaptive Generalized Fused-Lasso:
Asymptotic Properties and Applications

V. Viallon[‡], S. Lambert-Lacroix[†], H. Hoefling[◇] and F. Picard[⋆⋆]

[‡]Université de Lyon, IFSTTAR, UMR T 9405, UMRESTTE, Bron, F-69675, France
[⋆] LBBE, UMR CNRS 5558 Univ. Lyon 1, F-69622 Villeurbanne, France
[◇] Novartis Pharma, Basel, Switzerland [1]
[†]UMR 5525 UJF-Grenoble 1/CNRS/UPMF/TIMC-IMAG, Grenoble, F-38041, France

Variable selection has been one of the most active field of research in the statistical litterature of recent years, with emphasis on ℓ_1-based penalization methods like the Lasso to allow both variable selection and shrinkage. Despite better accuracy, the Lasso suffers from some drawbacks such as bias and inconsistency in some cases, especially when features are correlated. Extensions of the Lasso have been proposed like the Adaptive Lasso that uses adaptive weights to enjoy the oracle property (sparsistency and optimal estimation rate). Another direction has been to incorporate additional knowledge within the penalty to account for some structure among features. The Fused-Lasso can be viewed as a first attempt as it penalizes the difference between coefficients that correspond to successive features. This strategy has been further extended to the penalization of differences of coefficients corresponding to features organized along a network, through the Generalized Fused-Lasso. In this work we investigate the theoretical and empirical properties of the Adaptive Generalized Fused-Lasso in the context of Generalized Linear Models, with emphasis on Logistic Regression. More precisely, we establish its asymptotic oracle properties and propose an extensive simulation study to explore its empirical properties, and give some guidelines concerning the use of the Adaptive Generalized Fused penalty. We also propose an adaptation of the Relaxed Lasso that was proposed by Meinshausen (2007). This study is used to illustrate the interest of using ℓ_1-based penalization on differences compared with ℓ_2 strategies that have been proposed. Finally we propose an original application of the Generalized Fused-Lasso to the Joint Modeling framework where the design itself suggests the graph to be used in the penalty; an illustration is provided on road safety data.

Keywords. Variable selection, penalization, Network, Joint Modeling

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1. The views and opinions expressed herein are those of the author and do not necessarily reflect the views of Novartis.