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Use of the Elastic-Net algorithm for genomic selection in dairy cattle

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Background :

The availability of the 54K SNP array in dairy cattle makes possible to envision the use of genomic prediction instead of classical genetic evaluations in selection programmes. However, this requires suitable statistical approaches as the number of observations is often much lower than the number of predictor variables.

In animal breeding, it is clear that for a given trait, not all SNP across the whole genome are close to QTLs for the trait, whatever their size. In this context, we applied the Elastic-Net method to simultaneously select among all SNP the ones which are related with the studied trait and estimate their effect. The Elastic-Net approach consists of a combination of Ridge Regression and of a LASSO algorithm. A parameter λ varying between 0 and 1 indicates the relative weight given to Ridge Regression in the Elastic-Net procedure (pure Ridge Regression algorithm if $\lambda=1$, pure LASSO algorithm if $\lambda=0$).

Results:

We present here an application of the Elastic-Net approach on a set of 694 bulls in Montbéliarde breed using data available in 2004. The phenotypes of these animals are Daughter Yield Deviations (DYD) calculated for the French Marker Assisted Selection program for milk, fat and protein yields and contents. To evaluate the performance of the Elastic-Net algorithm, we use a validation set of 227 bulls for the Montbéliarde breed with phenotypes (DYD) available in 2008. The Elastic-Net approach directly applied to the whole data set was very time consuming (more than 20 days for the Montbéliarde breed). We proposed an alternative two-step approach which allows performing the analysis in less than 1 day. In this two-step approach, relevant SNPs were first selected by looking at moving intervals of 500 SNP and then combined into a single analysis.

Conclusion:

Using the Elastic-Net approach with the whole data set is probably the best solution to obtain the optimal parameters. But, if we want to take into account the time consuming problem, the optimal Elastic-Net parameters are found using our two-step approach. A comparison with other methods is under way.