On conformational changes of proteins using collective motions in torsion angles and L_1 regularization

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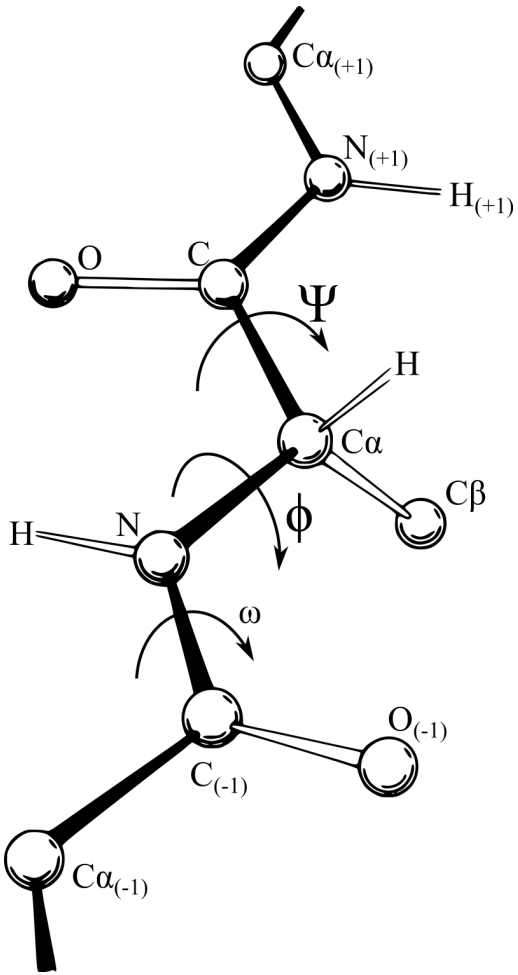
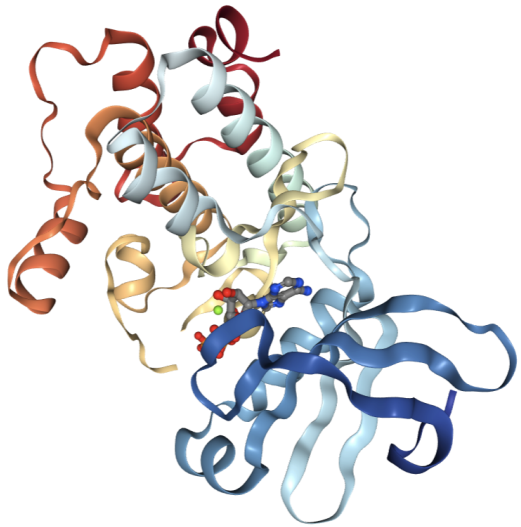
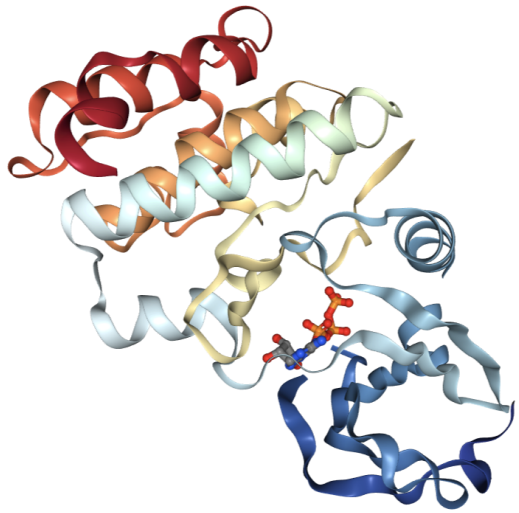
Overview

Conformational changes and normal modes in torsion angle space

Figure: Protein backbone and 1MQ4-10L6 conformational change







Problem

We address the question how well these conformational changes are described using only torsion angles, and how can the change in torsion angles be determined from the observed changes of Cartesian coordinates.

$$\Delta r = J\Delta\phi$$

$$\Delta\phi - ???$$

$$\frac{1}{2n}\|\Delta r - J\Delta\phi\|_2^2 + \alpha\|\Delta\phi\|_1$$

Overview of methods

Ridge regression

$$\min_{\Delta\phi} (\Delta\phi, J^\top MJ\Delta\phi) - 2(\Delta\phi, J^\top M\Delta r) + \lambda(\Delta\phi, \Delta\phi)$$

Least absolute shrinkage and selection operator

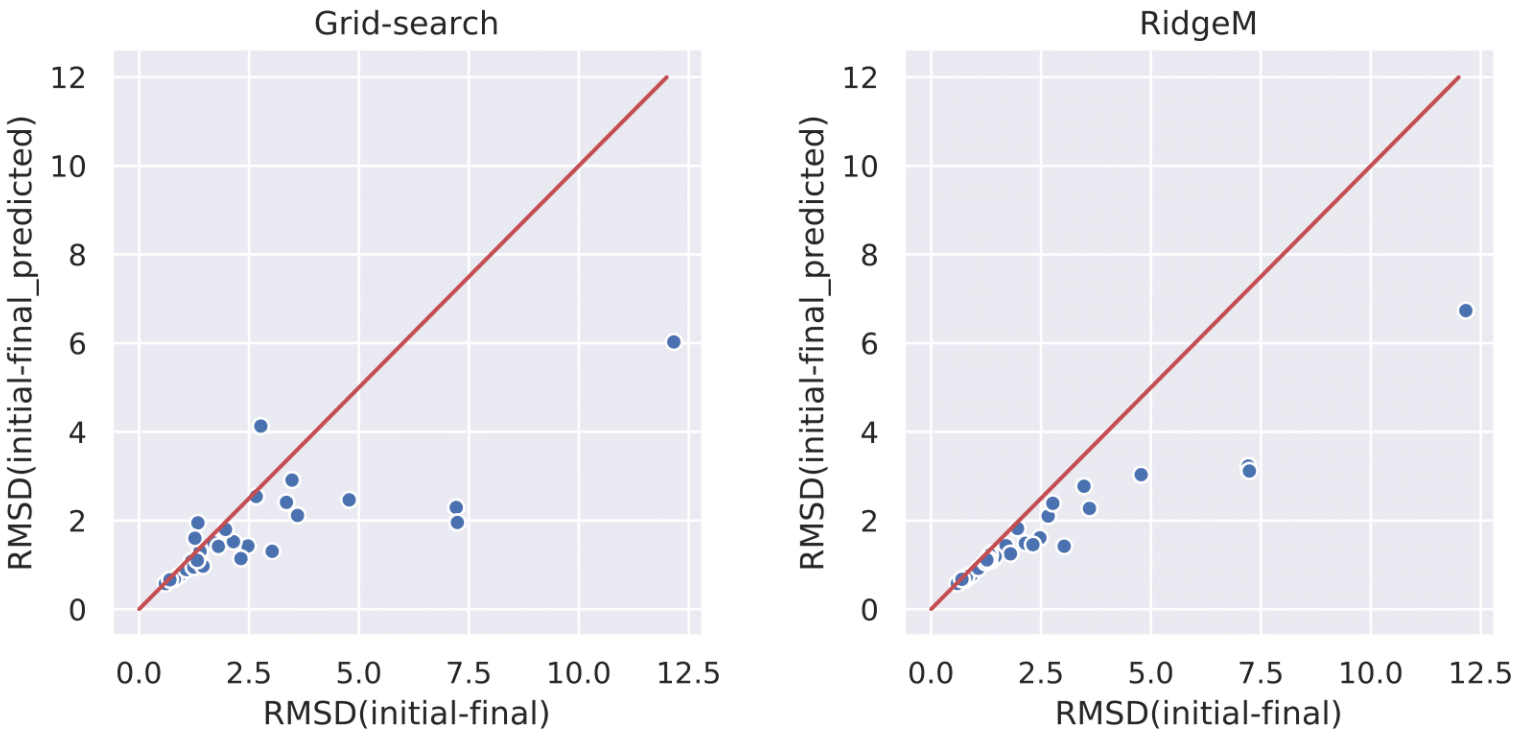
$$\min_{\Delta\phi} (\Delta\phi, J^\top MJ\Delta\phi) - 2(\Delta\phi, J^\top M\Delta r) + \lambda \sum_{j=1}^{p} |\Delta\phi_j|$$

Elastic net regularization

$$\min_{\Delta\phi} (\Delta\phi, J^\top MJ\Delta\phi) - 2(\Delta\phi, J^\top M\Delta r) + \alpha(\Delta\phi, \Delta\phi) + (1-\alpha) \sum_{j=1}^{p} |\Delta\phi_j|$$

Results

Figure: Correlation of RMSD in Grid search Lasso and Ridge regression



	LassoCV	EnCV	L=0	Ridge M	Ridge	LassoCVGS
Å	2.39	2.17	6.79	1.71	1.53	1.74

Results

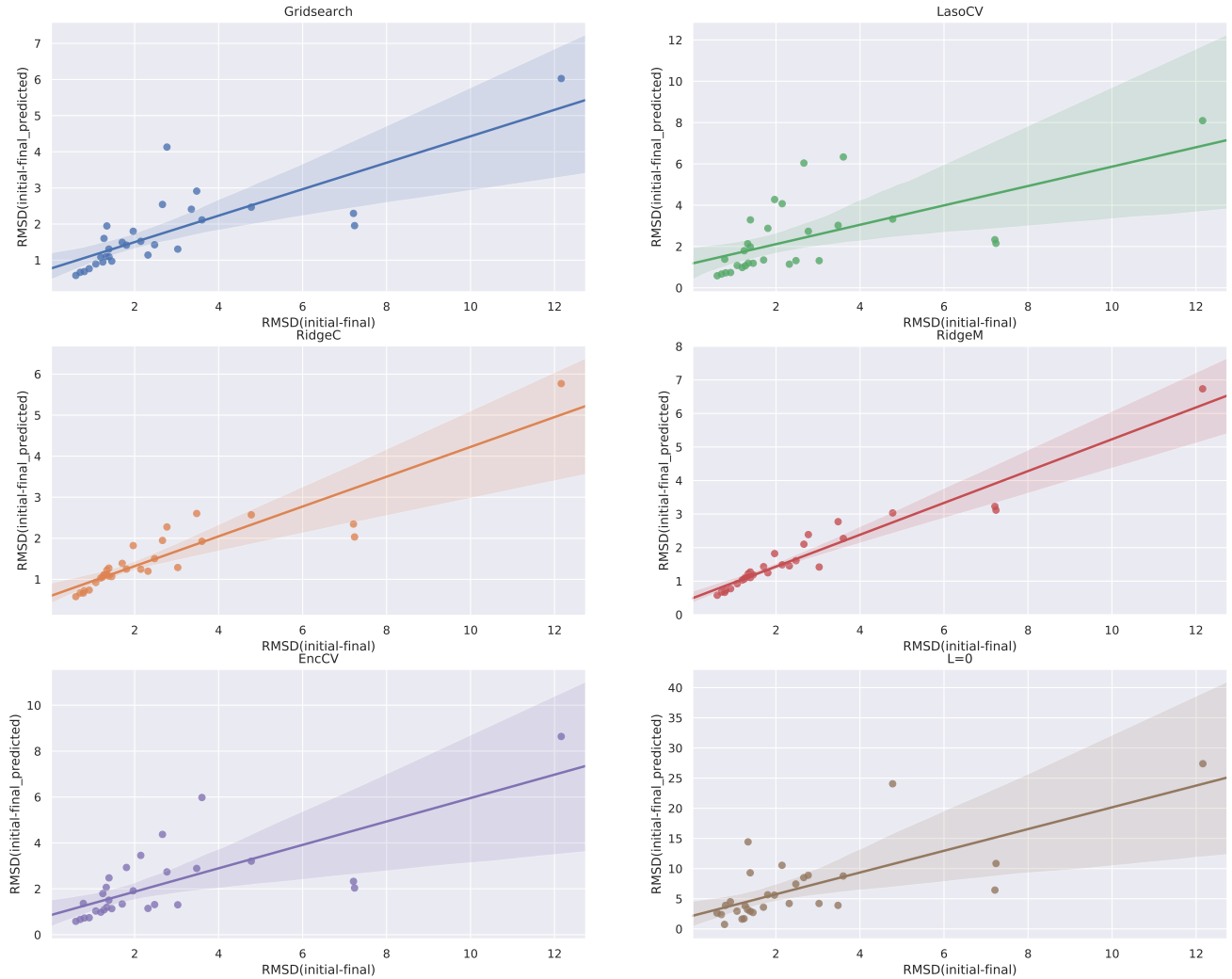


Figure: Comparison of correlations of RMSD in all methods(using linear approximation)

Thank you for your attention!