Incorporating the Priori information in very fast simulating optimization (VFSA)

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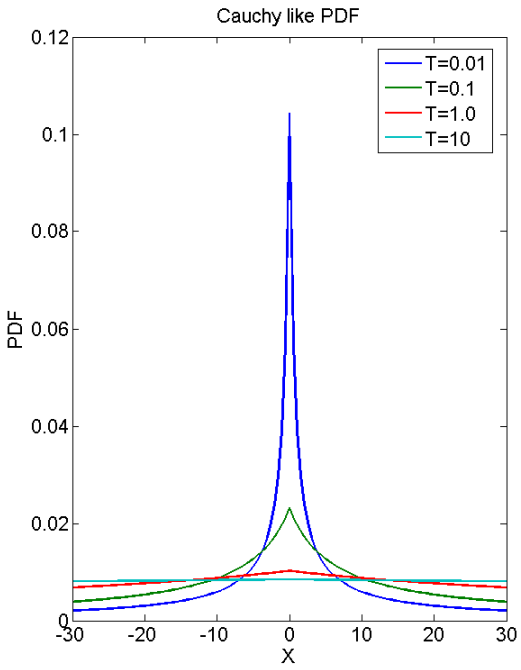
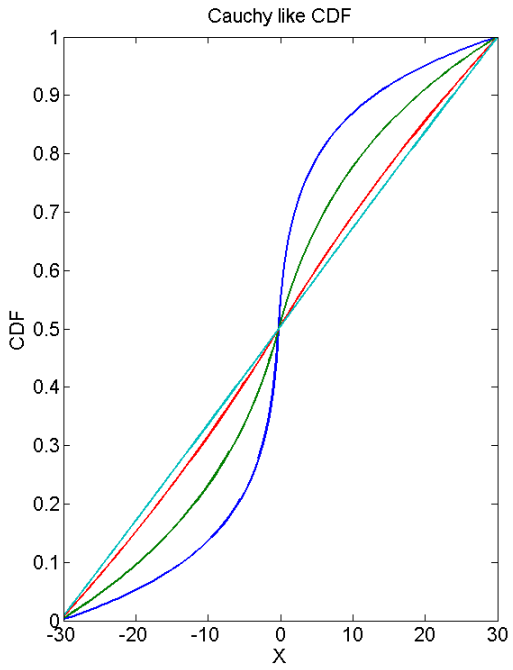
Cauchy like distribution

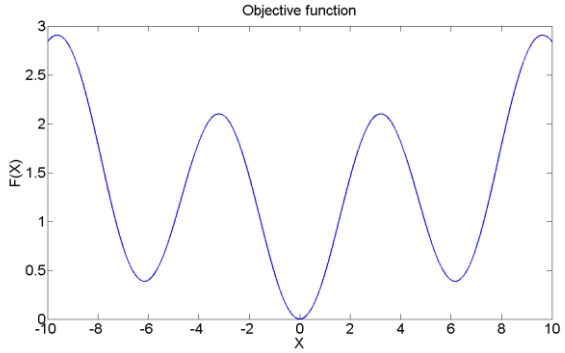


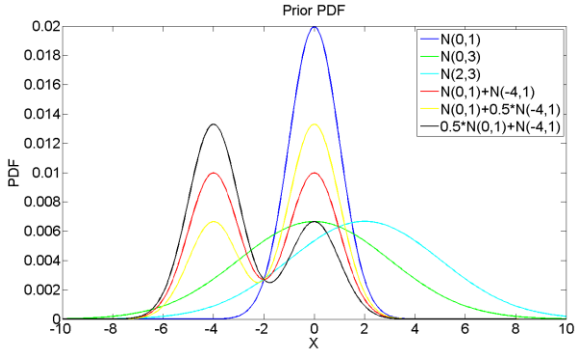


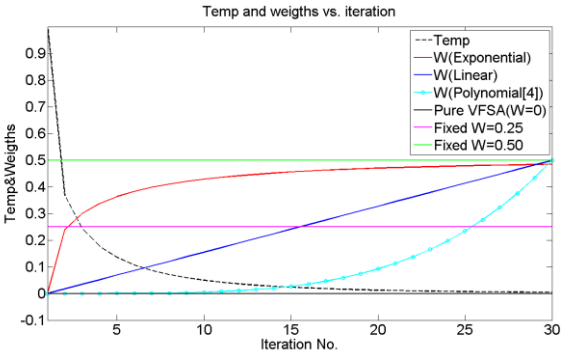
How to combine the prior knowledge with VFSA PDF?

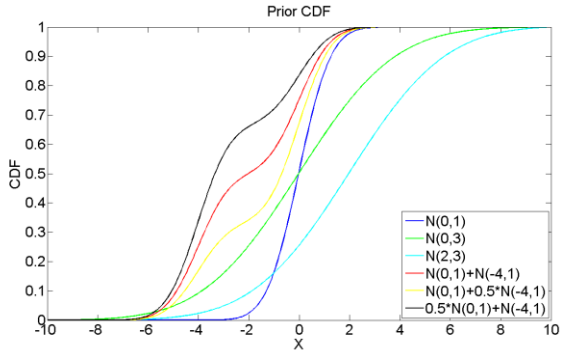
$$P_{Sampling} = P_{\Pr ior}^{w} * P_{VFSA}^{1-w}$$

Problem design

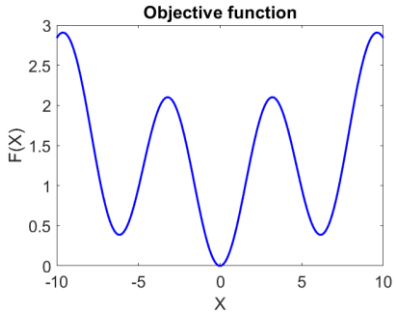


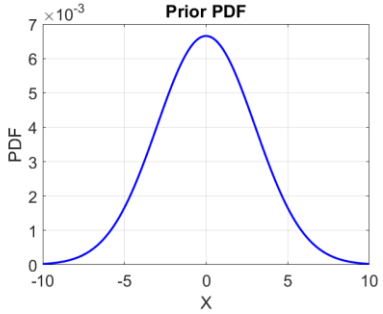


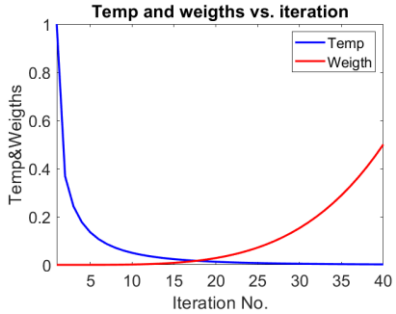


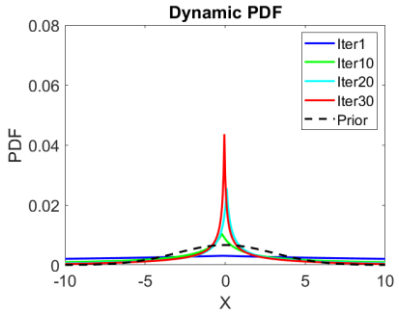


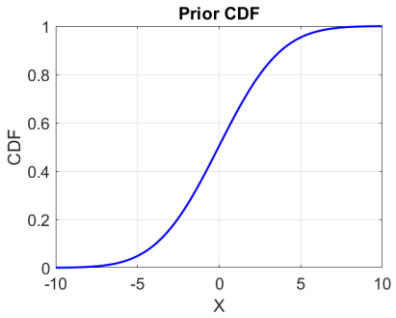
Problem design

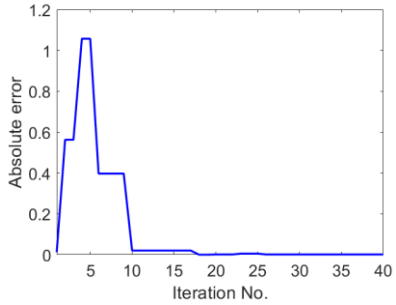


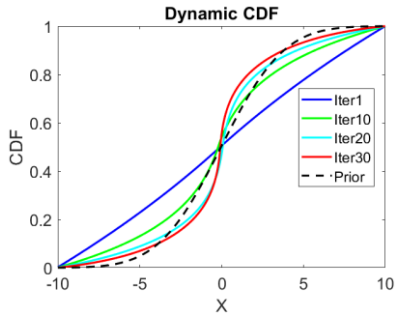


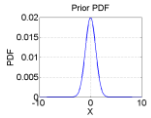




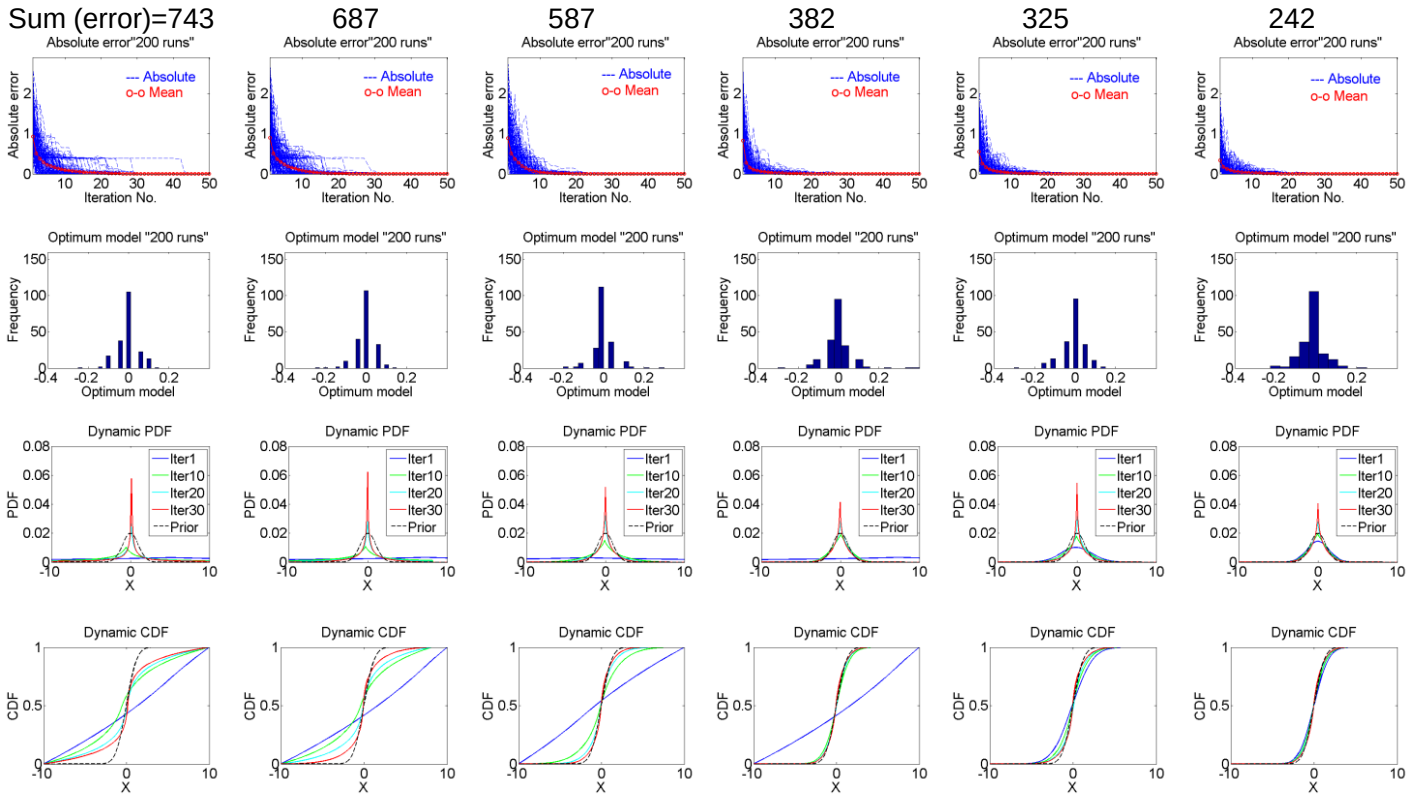




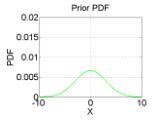




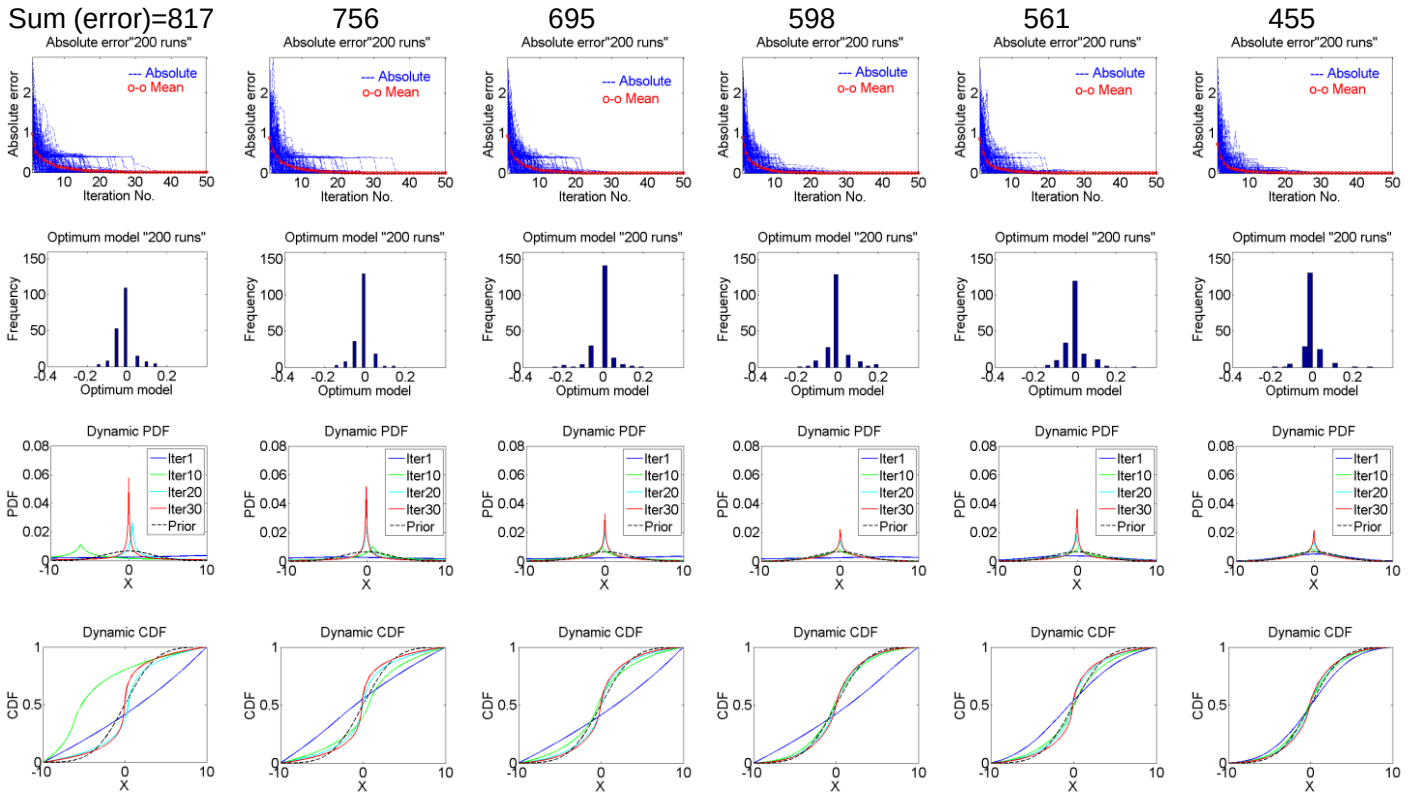
A unimodal Prior with low uncertainty : sharp Gaussian N(0,1)



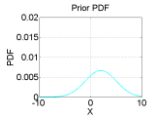
Pure VFSA (w=0) | Polynomial [4] | Linear | Exponential | w=0.25 | w=0.50



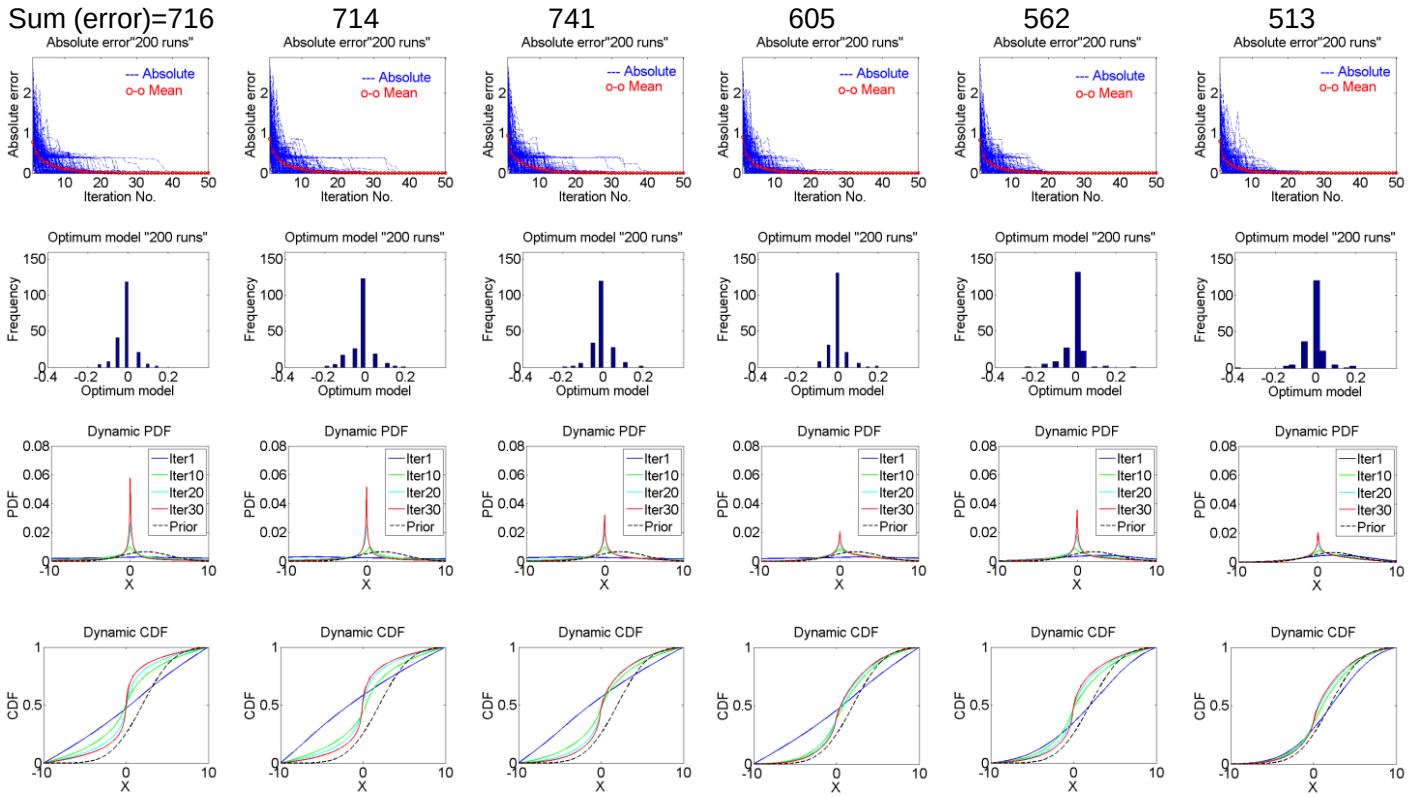
A unimodal Prior with high uncertainty : broad Gaussian N(0,3)



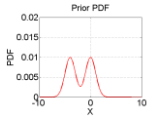
Pure VFSA (w=0) | Polynomial [4] | Linear | Exponential | w=0.25 | w=0.50



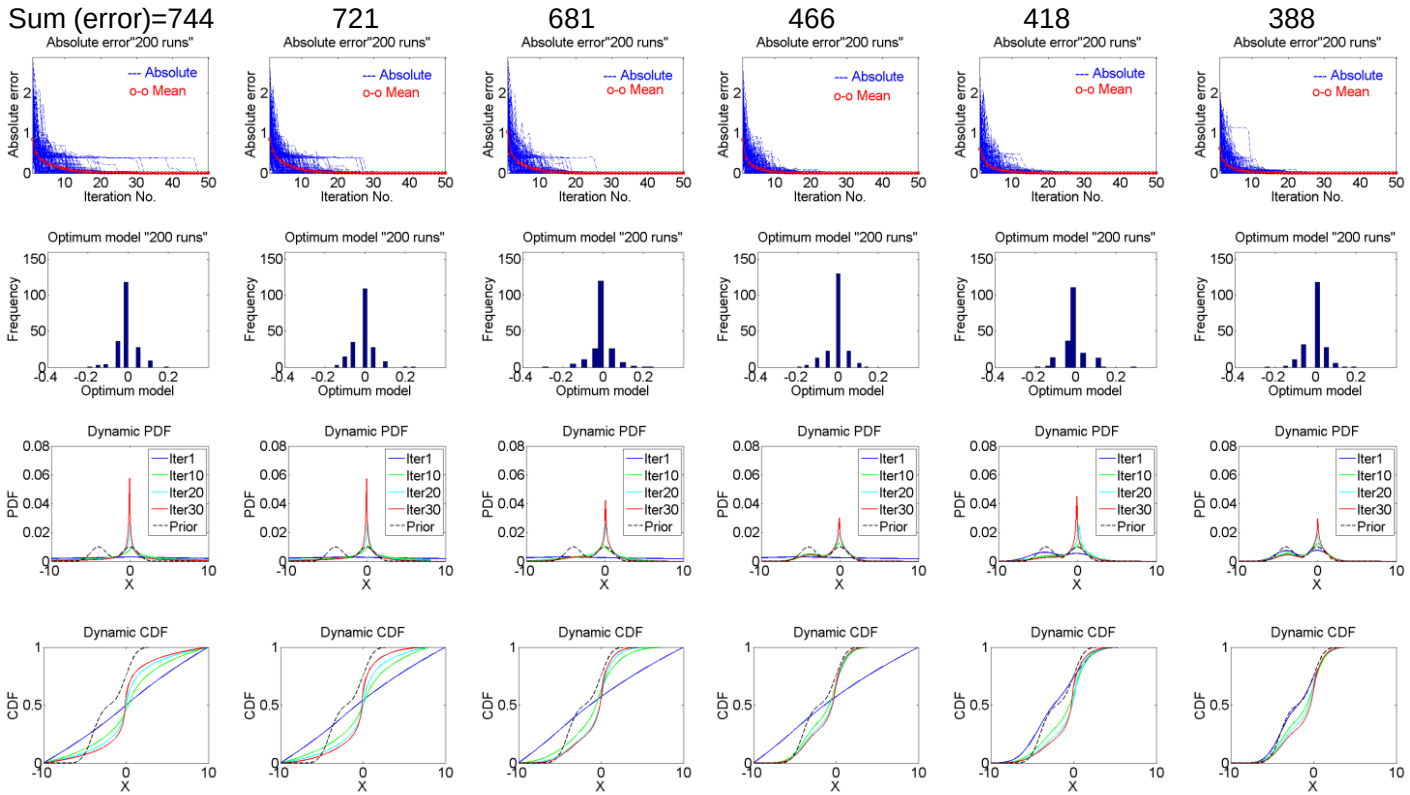
A deviated unimodal Prior : broad Gaussian N(2,3)



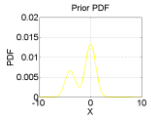
Pure VFSA (w=0) | Polynomial [4] | Linear | Exponential | w=0.25 | w=0.50



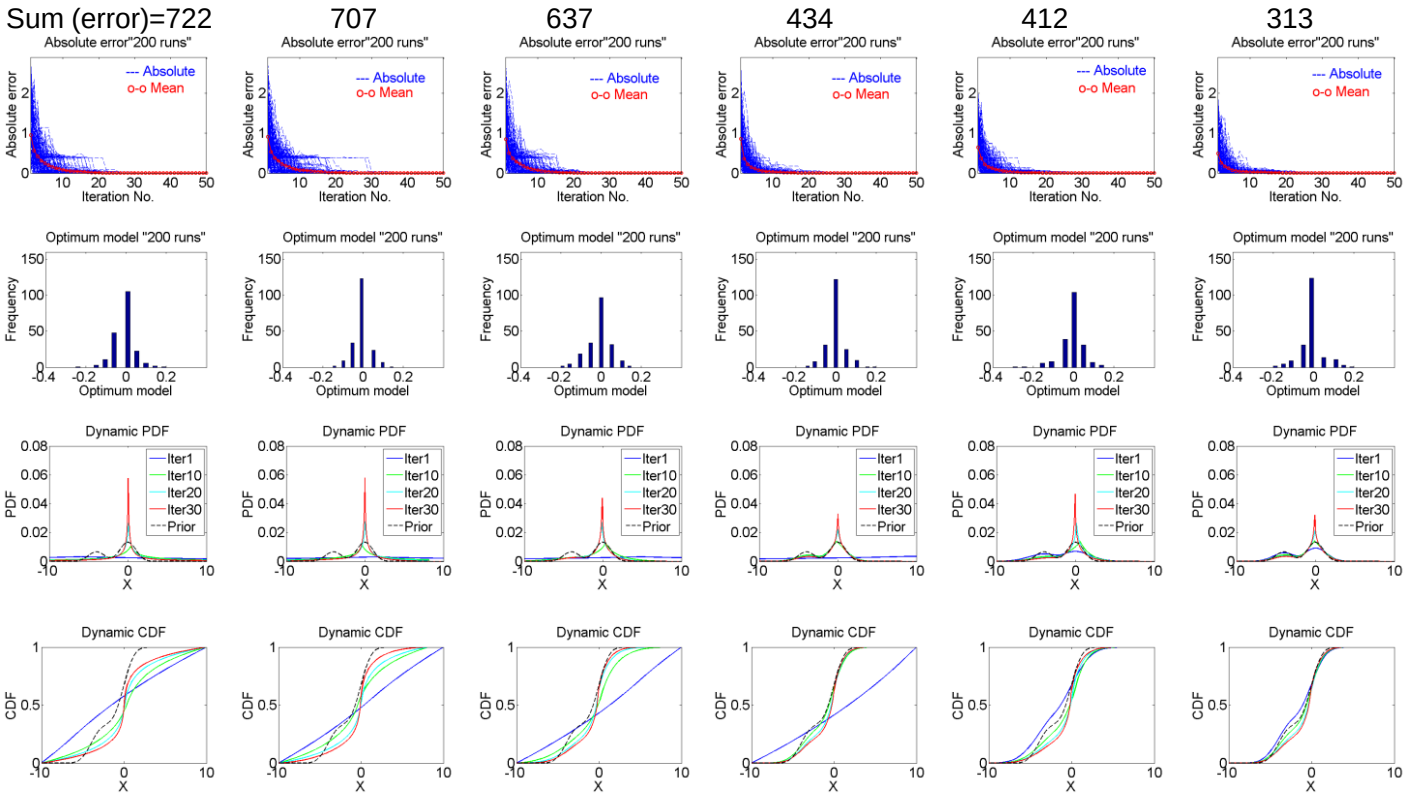
A equiprobable bimodal Prior simulating : N(0,1)+N(-4,1)



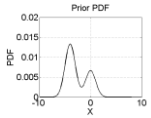
Pure VFSA (w=0) | Polynomial [4] | Linear | Exponential | w=0.25 | w=0.50



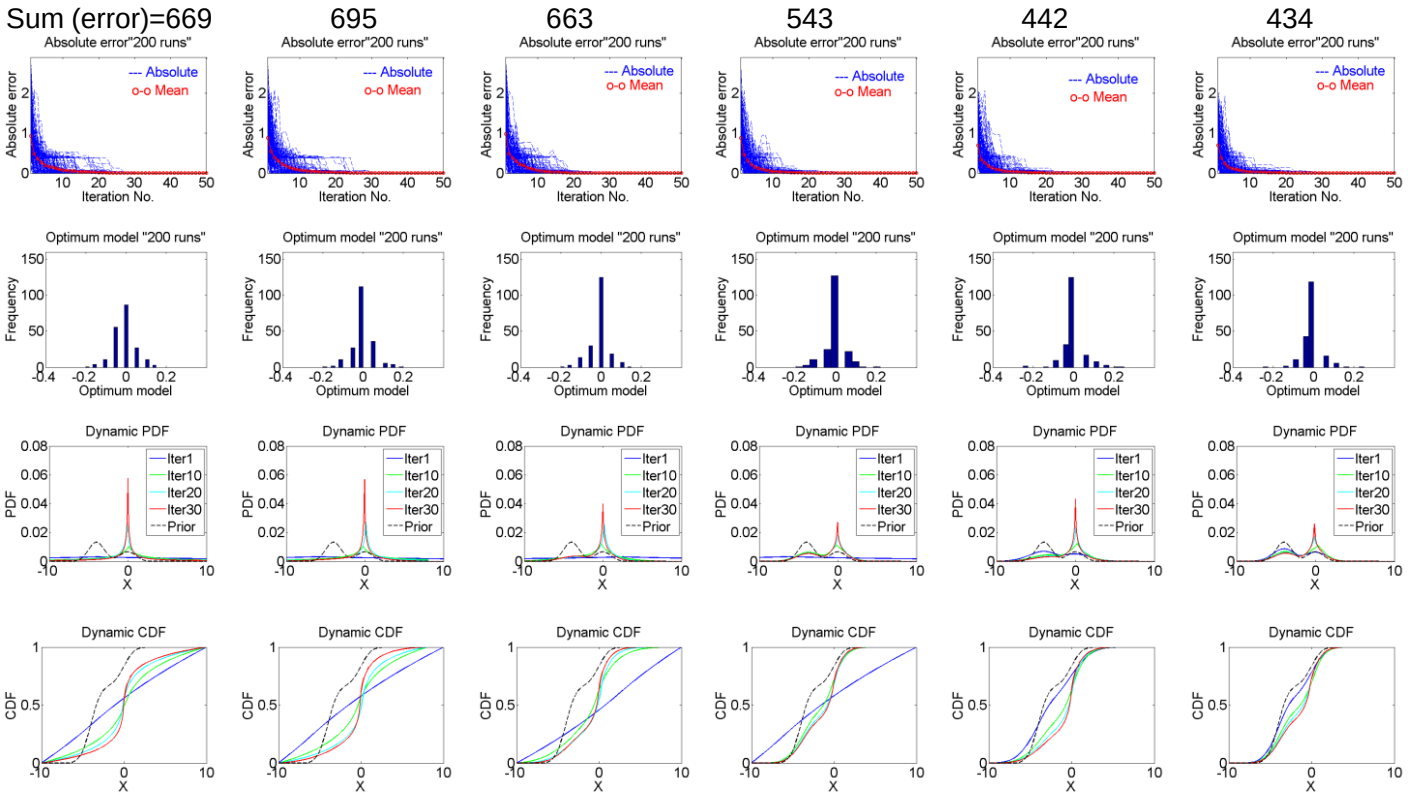
A bimodal Prior simulating high probability on target: N(0,1)+0.5*N(-4,1)



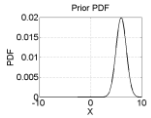
Pure VFSA (w=0) | Polynomial [4] | Linear | Exponential | w=0.25 | w=0.50



A bimodal Prior simulating low probability on target: 0.5*N(0,1)+N(-4,1)



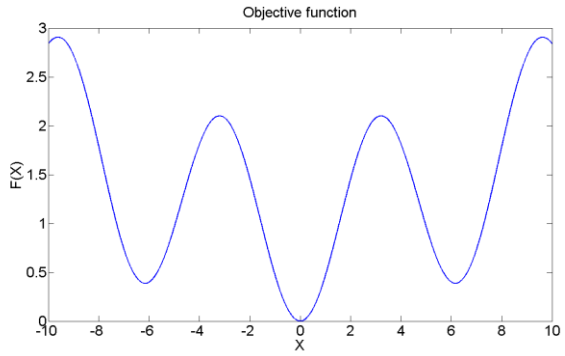
Pure VFSA (w=0) | Polynomial [4] | Linear | Exponential | w=0.25 | w=0.50

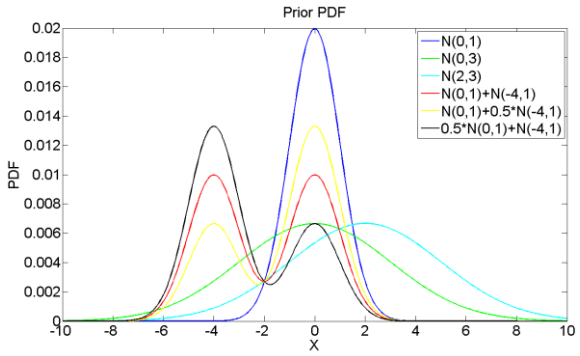


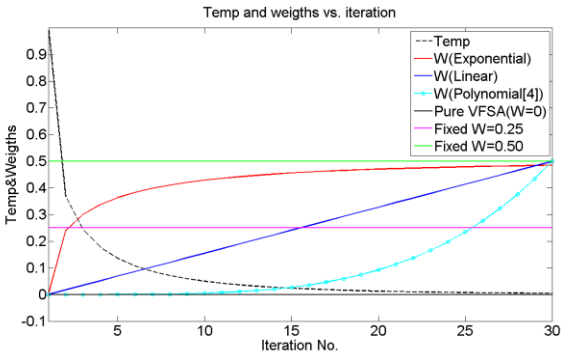
An erroneous unimodal Prior : N(6,1)

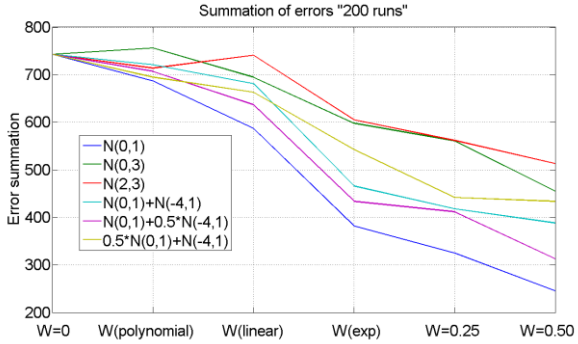
Sum (error)=734	715	1492	3963	3805	4123
Pure VFSA (w=0)	Polynomial [4]	Linear	Exponential	w=0.25	w=0.50

Summary of experiment









Summary of experiment

- A simple objective function with a global minimum @ (0,0) has considered to test incorporating a Prior knowledge in VFSA optimization.
- The experiment has repeated for 200 runs with 50 iterations for each run, all starting with same initial.
- Different kinds of Priors are taken into account to simulate different scenarios of Priors.
- Various ways to incorporate Priors are tested. This is done with different weights as a function of temperature or iteration number. Here we examine constant, linear, polynomial, and exponential weights.
- Error for each run is calculated and the best model corresponding to the minimum error for each run is obtained.
- The area under the error function, the integral of error function, is treated as a criterion to compare various weights, i.e., the smaller the area, the better weight function.

Summary of experiment

- For all kinds of Priors, it has been shown that a faster convergence can be reached, by moving from w=0, to polynomial, linear, exponential, w=0.25, and w=0.50.
- The broader a Prior, the longer convergence time.
- The VFSA can easily handle erroneous broad Priors and find global minimum, but it hardly converges when combine with erroneous sharp Priors.
- Three different bimodal distributions help to reach faster convergence.
- It is hard to judge PPD of model parameter.
- The results can not be generalized to any inverse problem, but the algorithm is flexible enough to be adjusted with any inverse problem by tuning the appropriate parameters of weight function.