

Simplex constrained QP formulation

$$\begin{aligned} \min_{\mathbf{u}=(\mathbf{y}, \mathbf{x}, \mathbf{s}, \kappa, \tau)} \quad & f(\mathbf{u}) := \frac{1}{2} \|\hat{\mathbf{A}}\mathbf{u}\|^2 \\ \text{subject to} \quad & \mathbf{e}^\top \mathbf{u} = 1 \\ & \mathbf{u} \geq \mathbf{0}. \end{aligned}$$

Using the potential function

$$\varphi(\mathbf{u}) := \rho \log(f(\mathbf{u})) - B(\mathbf{x}) - B(\mathbf{s}) - \log \kappa - \log \tau$$

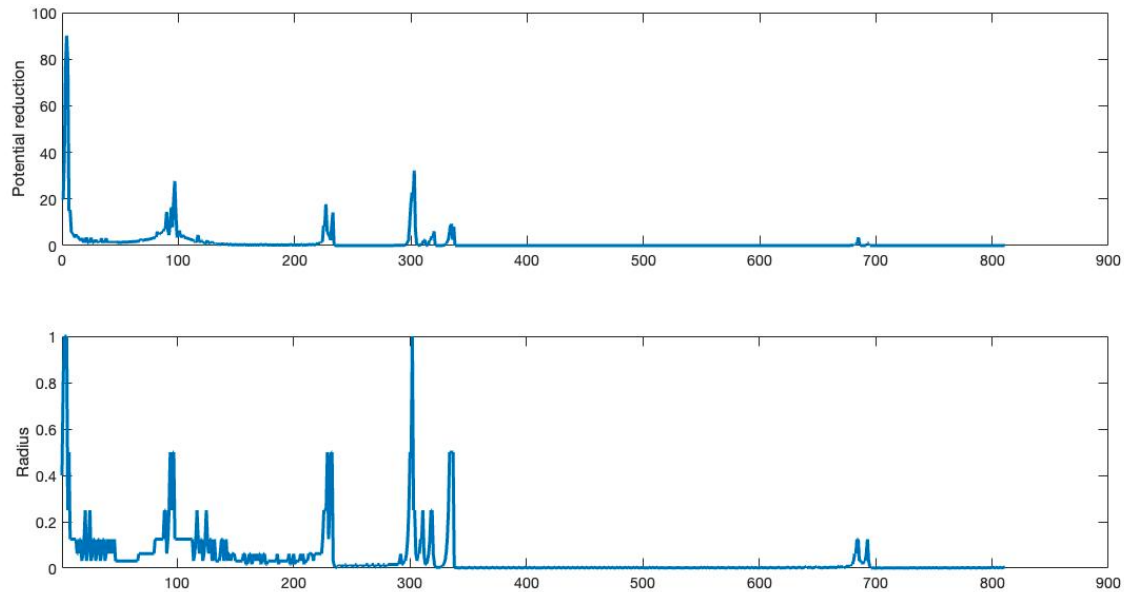
- $\mathbf{y}$  is treated unconstrained

$$\begin{aligned} \min_{\mathbf{d}, \alpha^g, \alpha^m} \quad & \frac{1}{2} \mathbf{d}^\top \mathbf{H} \mathbf{d} + \mathbf{h}^\top \mathbf{d} \\ \text{subject to} \quad & \|\mathbf{X}^{-1} \mathbf{d}_{\mathbf{x}}\|^2 + \|\mathbf{S}^{-1} \mathbf{d}_{\mathbf{s}}\|^2 + |\kappa^{-1} \mathbf{d}_{\kappa}|^2 + |\tau^{-1} \mathbf{d}_{\tau}|^2 \leq \beta_1 \leq 1 \\ & \mathbf{d} = \alpha^g \mathbf{g}^k + \alpha^m \mathbf{m}^k. \end{aligned}$$

The new method

- is able to solving NETLIB LPs to  $10^{-3} \sim 10^{-4}$  relative accuracy (20000 iterations)
- slows down in reducing potential half way

iter	fval	pot	alphag	alpham	beta	potred
1	+3.62e-02	-5.69e+02	-1.42e-04	+0.00e+00	+2.00e-01	-6.22e-01
1501	+4.90e-05	-1.92e+03	-9.32e-06	+3.96e-04	+1.00e+00	-5.44e-01
2001	+1.48e-05	-2.16e+03	-2.86e-05	+8.38e-04	+1.00e+00	-2.07e+00
3001	+1.53e-06	-2.60e+03	-7.91e-07	-7.13e-05	+1.00e+00	-3.25e-02
4501	+3.40e-07	-2.90e+03	-7.07e-08	+8.28e-08	+1.00e+00	-1.02e-03
5001	+2.91e-07	-2.93e+03	-6.57e-07	+1.21e-05	+1.00e+00	-3.25e-01
5501	+1.87e-07	-3.02e+03	-1.28e-07	+5.77e-08	+1.00e+00	-2.97e-03
6001	+1.78e-07	-3.03e+03	-2.03e-06	+7.40e-06	+1.00e+00	-3.14e-02
6501	+1.66e-07	-3.04e+03	-1.90e-07	-5.17e-07	+1.25e-01	-3.13e-03
7001	+1.62e-07	-3.04e+03	-1.43e-07	+1.59e-07	+1.00e+00	-1.81e-03
7501	+7.63e-08	-3.19e+03	-3.32e-06	-3.56e-06	+1.00e+00	-5.83e-02
8001	+7.17e-08	-3.20e+03	-9.93e-08	+3.50e-07	+1.00e+00	-1.50e-03
8501	+6.88e-08	-3.21e+03	-3.87e-08	+4.81e-07	+2.50e-01	-7.47e-03
9501	+6.37e-08	-3.23e+03	-5.37e-07	-1.30e-06	+1.00e+00	-2.12e-03
10000	+5.78e-08	-3.25e+03	-4.95e-08	+1.69e-07	+6.25e-02	-2.00e-03



## Possible solutions

- Add more directions
- Use **high order** information from time to time
- Adaptive potential parameter  $\rho$