INVERSION OF LATERAL LOGGING SOUNDING ON THE BASE OF MODIFIED OPTIMIZATION ALGORITHM.

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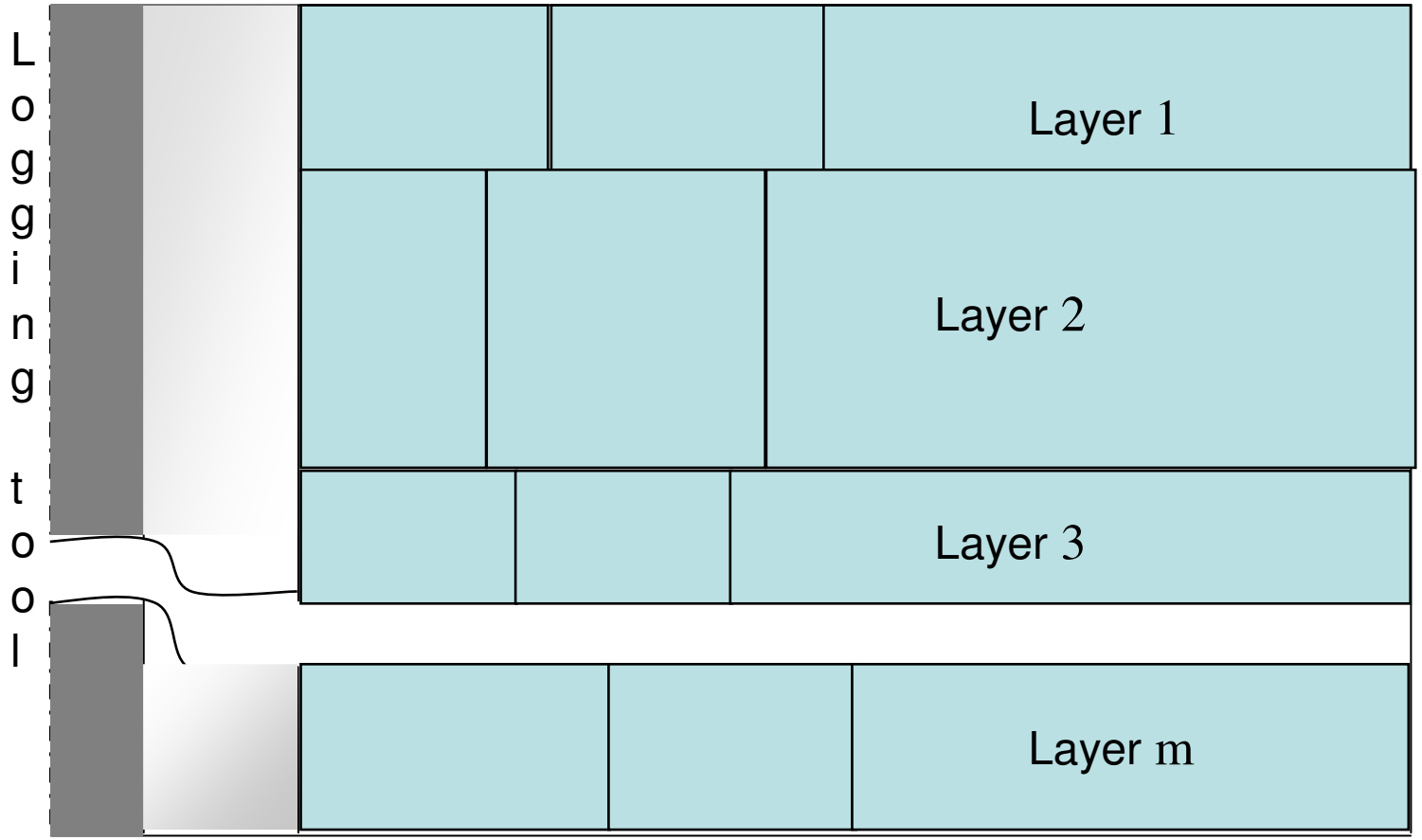
- The geophysical model



- The direct problem

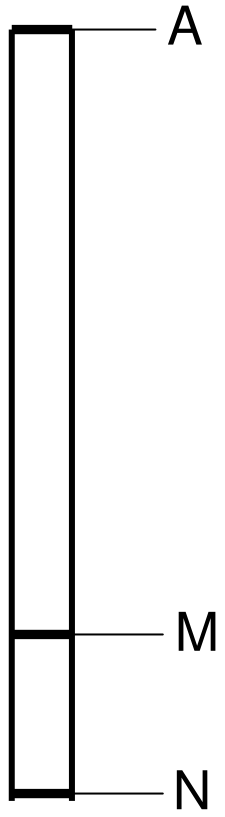
$$\rho_k = k\frac{\varphi_M - \varphi_N}{I_0^A}$$

$$-\operatorname{div}\frac{1}{\rho}\operatorname{grad}\varphi = 0$$

$$\varphi\big|_{\Gamma_0} = 0$$

$$\frac{1}{\rho}\frac{\partial\varphi}{\vec{n}}\bigg|_{\Gamma_1} = 0$$

$$\frac{1}{\rho}\frac{\partial\varphi}{\vec{n}}\bigg|_{\Gamma_1^A} = j_0^A$$



- The inverse problem

$$\mathrm{f}(\vec{x}) = \frac{1}{n}\sum_{j=1}^{n}\frac{\left|\rho_j - \rho_j^a(\vec{x})\right|}{\rho_j}$$

$$\vec{x} \in \left[\vec{a}, \vec{b}\right] \quad \vec{x} \in \mathrm{R}^n \qquad a_i \le x_i \le b_i$$

f

$$Arg\min \mathrm{f}(\vec{x}) = \vec{x}^*$$

$$\vec{x}^* \in X^* : \mathrm{f}(\vec{x}) < \mathrm{f}^*$$

The multi-start algorithm

- x= generate()
- y= localMin(x)
- update(s, y)

$$A(y) = \{x \mid y = localMin(x)\}$$

The Modified Multi-start algorithm

$D(x,y) = ||x-y||$

$\min D(x, \Omega) = \arg\min D(x,y): \quad y \in \Omega$;

generate() $= \arg\max (\min D(x, \Omega))$;

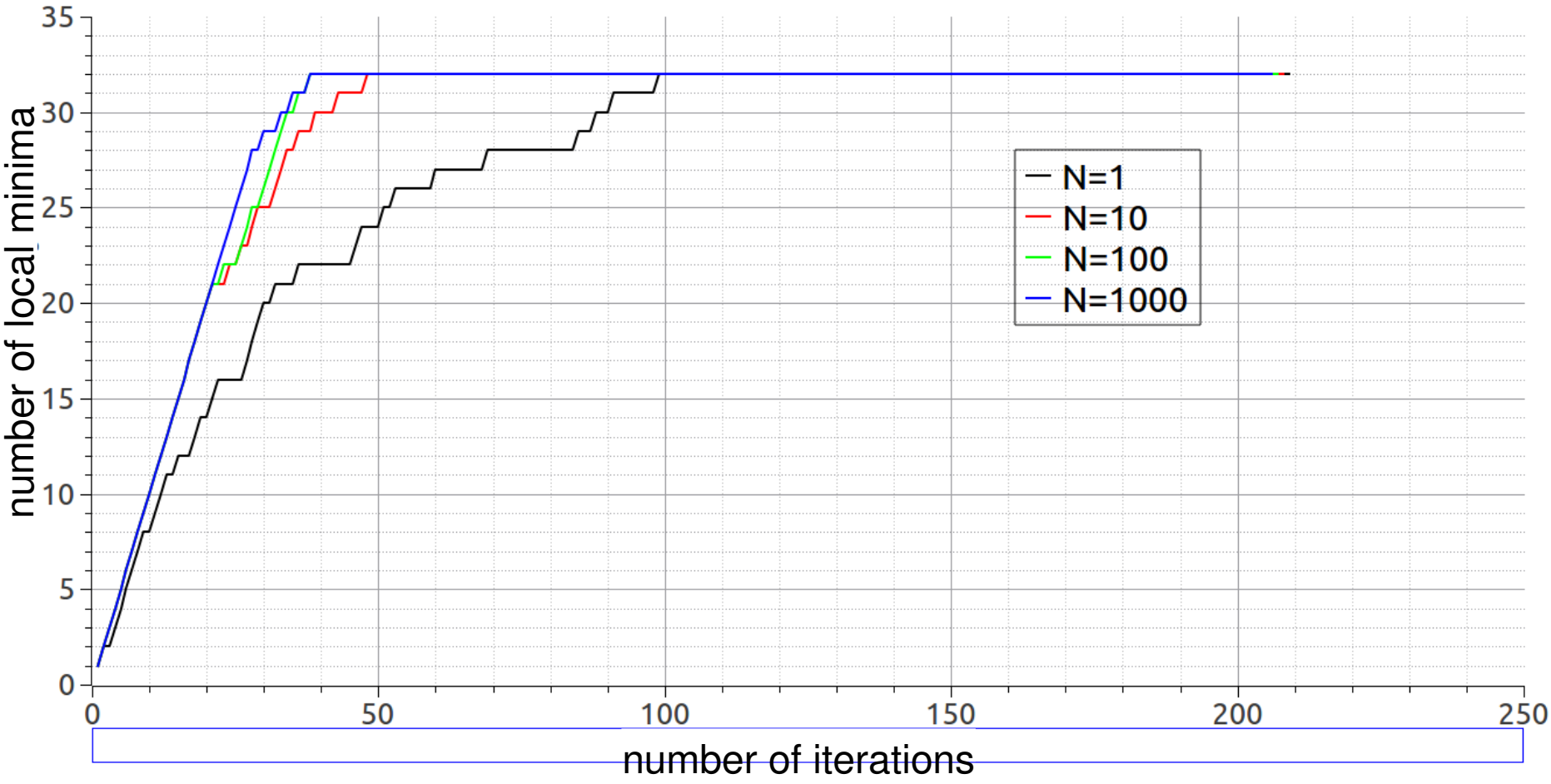
$\Omega = \{ x \mid f(x) \}$;

The pure random search algorithm

- $X \sim$ Uniform
- If $\text{minD}(x, \Omega) > \text{minD}(y, \Omega)$ then $y = x$

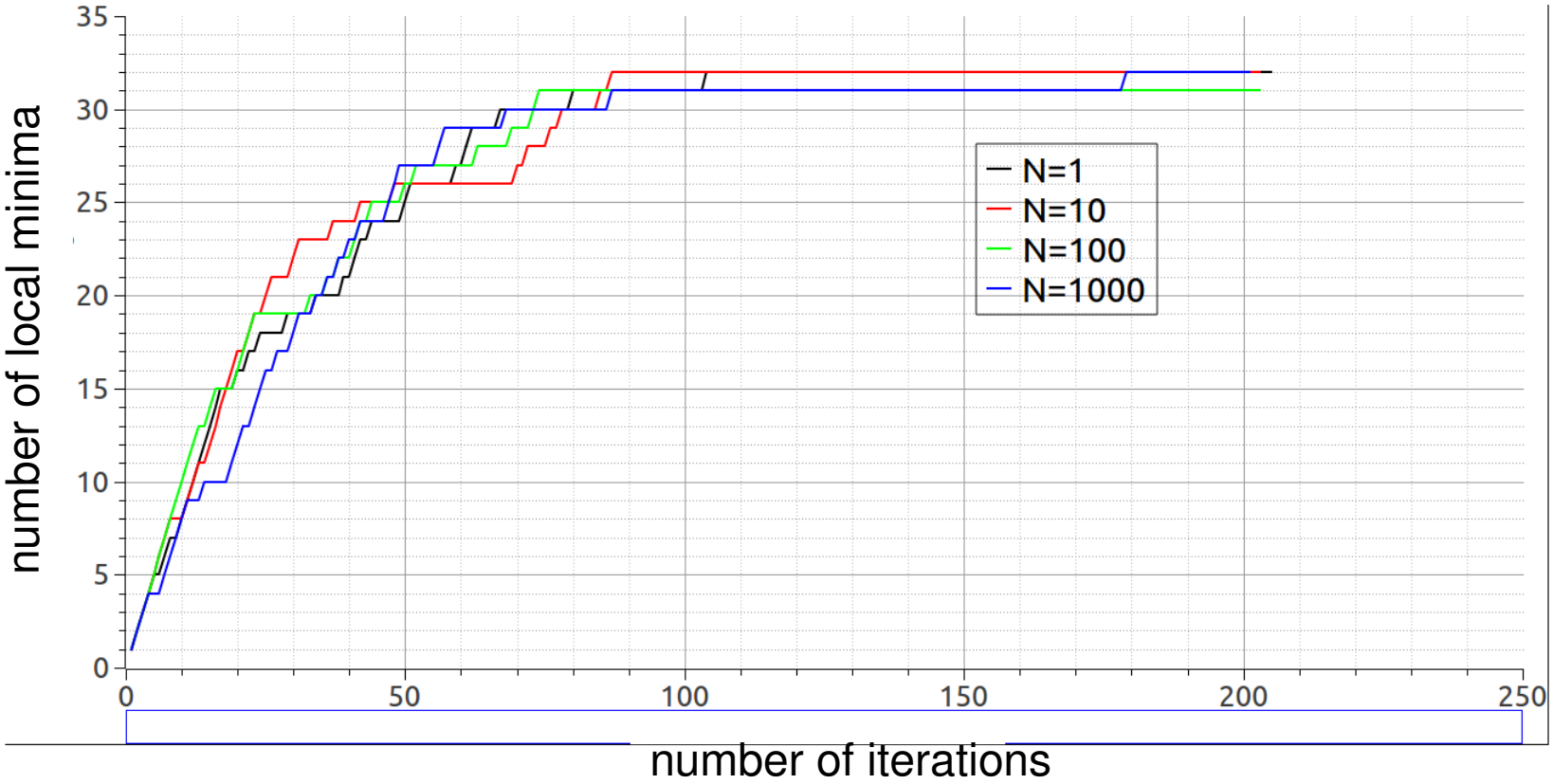
$$\Sigma\,(x_i - 2/6)^2 * (x_i + 2/6)^2; \qquad x_i \in [-1,1]$$

2^K - solutions, $k=5$



$$\Sigma\,(x_i - 1/6)^2 * (x_i + 1/6)^2; \qquad x_i \in [-1,1]$$

2^K - solutions, k=5



The geophysical test problems

A 0.2 M 0.1 N,
A 0.4 M 0.1 N,
A 1.0 M 0.1 N,
A 2 M 0.5 N,
A 4 M 0.5 N,
A 8 M 1 N.

resistivity of drilling mud is 2 Omm,
borehole radius is 0.1 m.

	zone 1 resistivity Omm	zone 1 width m	zone 2 resistivity Omm	zone 2 width m	layer resistivity Omm
Priori given solution	22	0.3	4	0.2	20

f(x)	zone 1 resistivity Omm	zone 1 width m	zone 2 resistivity Omm	zone 2 width m	layer resistivity Omm
0.0059	22.7	0.275	3.58	0.192	19.8
0.013	28.8	0.107	9.85	0.526	20.8
0.014	19.6	0.400	4.54	0.183	20.5
0.039	17.6	0.800	4.00	0.100	21.2
0.047	17.2	0.990	13.9	0.330	22.0

	layer #	zone resistivity Omm	zone width m	layer resistivity Omm
Priori given solution	1	8	0.5	14
	2	15	0.5	5
	3	15	0.3	25

f(x)	layer #	zone resistivity Omm	zone width m	layer resistivity Omm
0.0014	1	8.03	0.503	14.0
	2	15.1	0.501	5.00
	3	15.5	0.321	25.1

	zone 1 resistivity Omm	zone 1 width m	zone 2 resistivity Omm	zone 2 width m	layer resistivity Omm
Priori given solution	15	0.5	-	-	5

f(x)	zone 1 resistivity Omm	zone 1 width m	zone 2 resistivity Omm	zone 2 width m	layer resistivity Omm
0.0019	14.9	0.509	5.20	0.868	4.98
0.0023	15.4	0.394	12.3	0.127	5.02
0.004	14.8	0.267	20.4	0.148	4.98
0.005	15.3	0.2	13.1	0.359	5.00

Thank you for your attention