2d inversion recipes

ER inversion

This process is repeated for each experiment (i.e. each source s and all its receivers),

1. compute synthetic data d and error $e = d - d^o$,
2. correct error amplitude by its variance,
$$e \leftarrow \frac{e}{1 + \mathrm{std}\,(d^o)}$$
3. compute $g = J^\top e$, filter out high spatial-frequencies and normalize by largest amplitude,
4. compute $\sigma_{err} = \sigma - \sigma_{ref}$, filter out high spatial-frequencies and normalize by largest amplitude,
5. $g \leftarrow g + \beta\sigma_{err}$ and normalize g by largest amplitude,
6. compute step-size α_s using Pica and set $\Delta\sigma_s = -\alpha_s g$
7. store $\Delta\sigma_s$ and α_s.

After all sources have their update direction,

$$\alpha = \frac{1}{n_s}\sum \alpha_s$$
$$\Delta\sigma = \sum \Delta\sigma_s$$
$$\Delta\sigma_{dc} = \alpha\frac{\Delta\sigma}{\max|\Delta\sigma|}.$$

The conductivity is updated as,

$$\sigma \leftarrow \sigma \odot \exp\{\sigma \odot \Delta\sigma_{dc}\}.$$

GPR inversion ε

This process is repeated for each experiment (i.e. each source s and all its receivers),

1. compute synthetic data d and error $e = d - d^o$,
2. how to treat noise in e?
3. compute g_ε and apply Kurzmann preconditioner,
4. on $g_{w,\varepsilon}$ filter out high spatial-frequencies and normalize by largest amplitude,
5. compute step-size α using Pica and set $\Delta\varepsilon_s = -\alpha g_\varepsilon$
6. store $\Delta\varepsilon_s$,
7. invert for source wavelet with a Wiener filter,

$$\tilde{a}(\omega_o) = \frac{d_{w_o} \cdot (d^o_{w_o})^*}{d_{w_o} \cdot d^*_{w_o}} \qquad \text{for all } \omega_o \in \omega,$$
$$\tilde{s} \leftarrow \tilde{a} \odot \tilde{s}.$$

After all sources have their update direction,

$$\Delta\varepsilon = \frac{1}{n_s} \sum \Delta\varepsilon_s.$$

The permittivity is updated as,

$$\varepsilon \leftarrow \varepsilon \odot \exp\{\varepsilon \odot \Delta\varepsilon\}.$$

GPR inversion σ

This process is repeated for each experiment (i.e. each source s and all its receivers),

1. compute synthetic data d and error $e = d - d^o$,
2. how to treat noise in e?
3. compute $g_{w,\sigma}$ and apply Kurzmann preconditioner,

4. on $g_{w,\sigma}$ filter out high spatial-frequencies and normalize by largest amplitude,

5. compute step-size α using Pica and set $\Delta\sigma_s = -\alpha g_{w,\sigma}$

6. store $\Delta\sigma_s$,

7. invert for source wavelet with Wiener filter,

$$\tilde{a}(\omega_o) = \frac{d_{w_o} \cdot (d^o_{w_o})^*}{d_{w_o} \cdot d^*_{w_o}} \qquad \text{for all } \omega_o \in \omega,$$
$$\tilde{s} \leftarrow \tilde{a} \odot \tilde{s}.$$

After all sources have their update direction,

$$\Delta\sigma_w = \frac{1}{n_s} \sum \Delta\sigma_s.$$

The conductivity is updated as,

$$\sigma \leftarrow \sigma \odot \exp\{\sigma \odot \Delta\sigma_w\}.$$

GPR+ER inversion σ

The update direction is

$$\Delta\sigma \leftarrow \frac{1}{2}(\Delta\sigma_w + \Delta\sigma_{dc})$$

and the update for *both* the GPR and ER is

$$\sigma \leftarrow \sigma \odot \exp\{\sigma \odot \Delta\sigma\}.$$