Ground Penetrating Radar (GPR)

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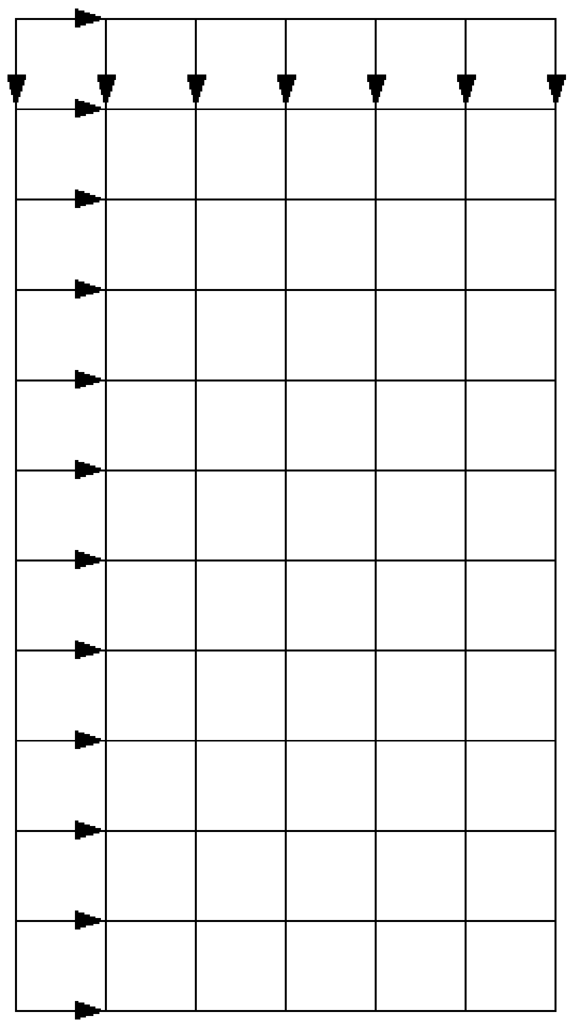
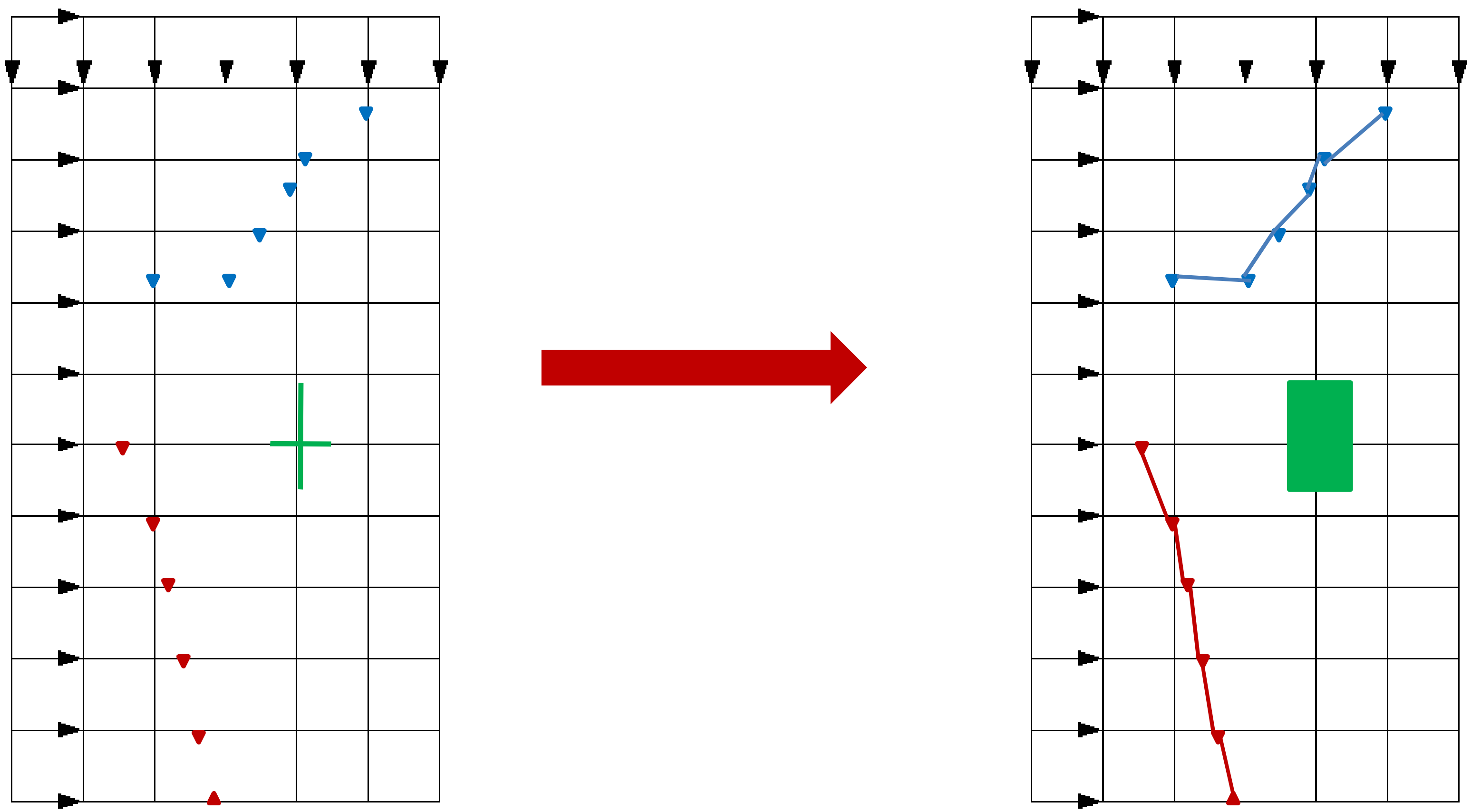
Outline

- 1. GPR in Practice
  - Data Collection
  - Interpretation
  - Deliverable
- 2. Finite Difference Time Domain (FDTD)
  - History
  - Theory
  - Implementation

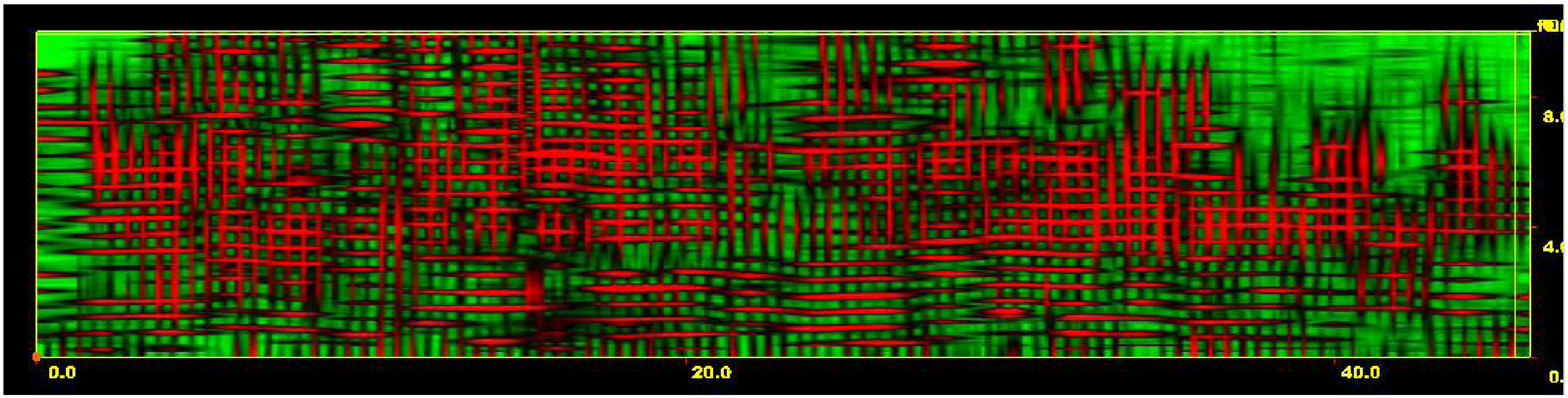
Data Collection

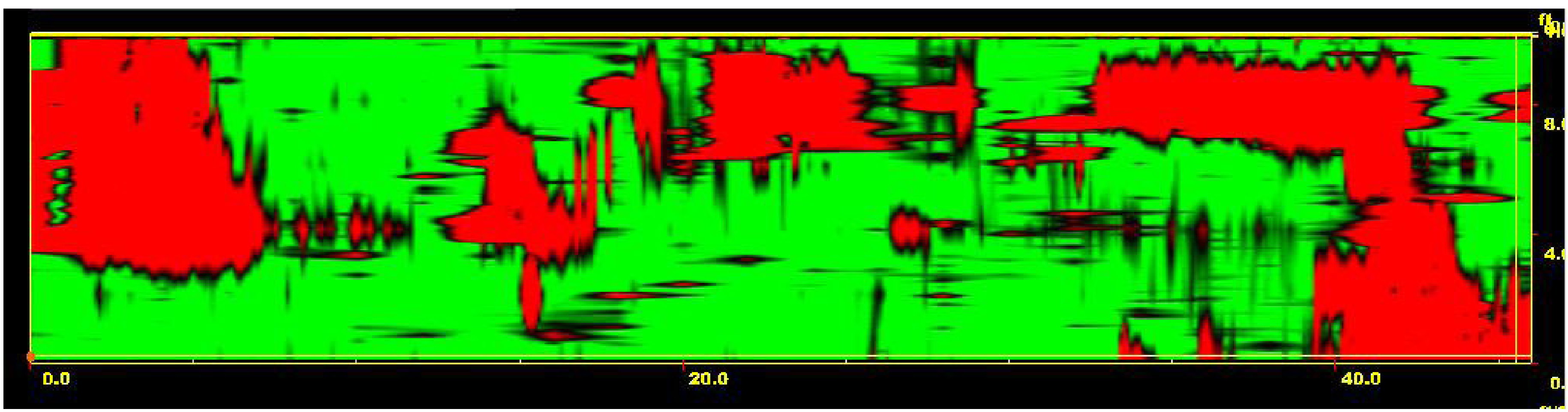


Data Interpretation



Imaging





Finite Difference Time Domain (FDTD)

- Numerical technique for modeling propagation of EM waves
- First paper: Kane Yee, 1966
- Growing number of applications

Theory: Maxwell's Equations

$$\frac{\partial E}{\partial t} = \frac{1}{\varepsilon_0} \nabla \times H$$

$$\frac{\partial H}{\partial t} = -\frac{1}{\mu_0} \nabla \times E$$

For 1D case:

$$\frac{\partial E_x}{\partial t} = -\frac{1}{\varepsilon_0} \frac{\partial H_y}{\partial z}$$

$$\frac{\partial H_y}{\partial t} = -\frac{1}{\mu_0} \frac{\partial E_x}{\partial z}$$

Constructing the Finite Differences

- Based on discretizing the small spatial and temporal steps

$$\frac{E_x^{n+1/2}(k)-E_x^{n-1/2}(k)}{\Delta t}=-\frac{1}{\varepsilon_0}\frac{H_y^n(k+1/2)-H_y^n(k-1/2)}{\Delta z}$$

$$\frac{H_y^{n+1}(k+1/2)-H_y^n(k+1/2)}{\Delta t}=-\frac{1}{\mu_0}\frac{E_x^{n+1/2}(k+1)-E_x^{n+1/2}(k)}{\Delta z}$$

End

- Thanks
- Questions?