

Airborne Radar Synthesis Multigrid Minimization

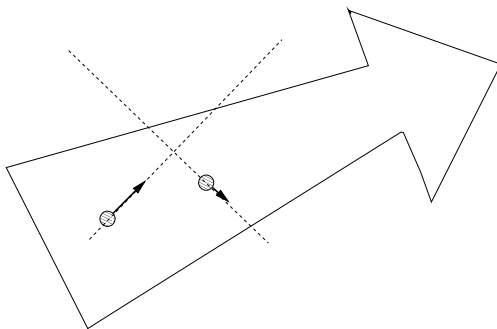
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Velocity field – Retrieval steps

- 1 Correct and threshold raw data as advised by NCAR.
- 2 Reduce radial velocities to eigen-velocities over a Cartesian Grid.
- 3 Search for a velocity field that:
 - minimizes missfit with gridded data
 - satisfy mass continuity.

Reduction of Radial Velocities



$$F(\vec{v}) = \sum_{Data} W_i (V_{ri} - \vec{v} \cdot \hat{\mathbf{n}}_i)^2 \quad (1)$$

Objective Function

$$F(\vec{v}) = \sum_{Grid} \left\{ \|MF\|^2 + W\|SM\|^2 + P \left[\|MC\|^2 + \|BC\|^2 \right] \right\} \quad (2)$$

Data Missfit

$$\|MF(\mathbf{v})\|^2 = \sum_{Data} \sum_{\alpha} a_{\alpha} [\mathbf{v}(r_d) \cdot \hat{\mathbf{e}}_{\alpha}(r_d) - U_{\alpha}(r_d)]^2 \quad (3)$$

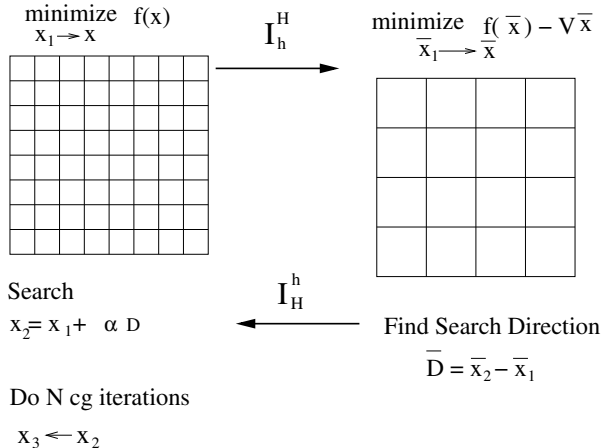
$$\mathbf{v}(r_d) = \sum_g A(g) \mathbf{v}(g) - \hat{\mathbf{k}} V_{tv}(r_d) \quad (4)$$

Lateral Boundary Conditions

$$\frac{\partial}{\partial x}(v_c) = 0; \quad \frac{\partial}{\partial y}(v_c) = 0 \quad (5)$$

$$\|BC\|^2 = \sum_{v_x, v_y, v_z} \left[\frac{\partial}{\partial x}(v_c) \right]^2 + \left[\frac{\partial}{\partial y}(v_c) \right]^2 \quad (6)$$

Schematic of Multigrid Minimization



Case Study: Nuri – 08-17-2008

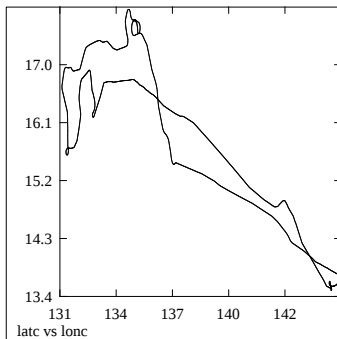


Figure: Nuri:08-17-2008

Results

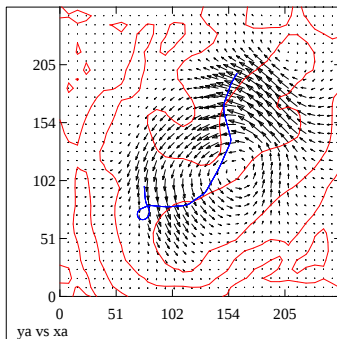


Figure: Nuri:08-17-2008: H = 2.1 km - o 131:15:0 - n 65:65:33 - d

Results

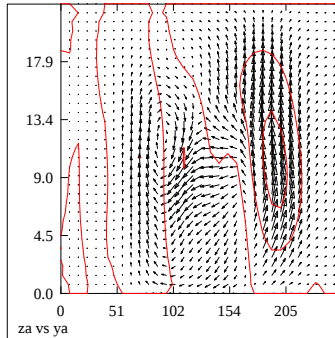
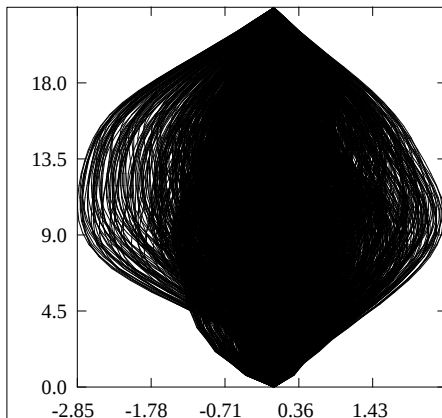


Figure: Nuri:08-17-2008: X = 156 km - o 131:15:0 - n 65:65:33 - d

Results



Summary

- Multigrid minimization achieve results comparable to conventional minimization techniques, but it has the potential to be faster on denser grids while keeping the accuracy of the results.