Stage 11: Warping the Manifold (Well Parser)

NGeodesic Project

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Stepwise Plan for Stage 11

This stage formalizes the "well" perspective by turning the parser into an explicit energy minimization problem. The goal is to warp the manifold into a deep basin that suppresses hallucinations and stabilizes true solutions.

Step 1. Formalize the Energy Landscape

Define a per-primitive potential

$$U_p = -\left(w_\perp z_{\perp,p} + w_{\mathrm{raw}} z_{\mathrm{raw},p} - w_{\mathrm{cm}} z_{\mathrm{cm},p}\right). \tag{1}$$

The margin

$$\Delta = U_{\mathrm{false}} - U_{\mathrm{true}} \tag{2}$$

is the measure of well depth.

Step 2. Improve Orthogonalization

Replace mean-only subtraction with low-rank projection. Compute top-r principal components across primitives, then project onto the orthogonal complement. This enlarges Δ by removing more shared variance.

Step 3. Strengthen Calibration

Enhance the permutation null:

- Use block circular shifts to preserve autocorrelation.

- Optionally apply multitaper averaging for variance reduction.

Step 4. Sequential Residual Refinement

After selecting a primitive, subtract its prototype contribution from all channels and recompute z-scores. True picks reduce residual energy, deepening the well; false picks do not.

Step 5. Lateral Inhibition

Introduce penalties when two primitives activate in overlapping windows. Implement as a Gaussian kernel $\kappa(t_i, t_j)$ in the energy function to suppress distractor basins.

Step 6. Controlled Descent

Introduce a temperature parameter T:

$$\pi(p) \propto \exp(-U_p/T). \tag{3}$$

Start with high T (exploration) and anneal to low T (deep well, stable convergence).

Step 7. Evaluation Metrics

Track margin distributions and performance metrics as each component is added:

- Hallucination rate should decrease steadily.

- Recall should remain stable ($\pm 2\%$).

- F_1 and Jaccard scores should climb.

- Exact grid accuracy should rise meaningfully.

Breaking Point

Stage 11 represents the **breaking point** of the project: the transition from heuristic parsing to an explicit warped manifold energy framework. This is where hallucinations are eliminated by construction.