Optimal Seed Generation for 3D Reconstruction

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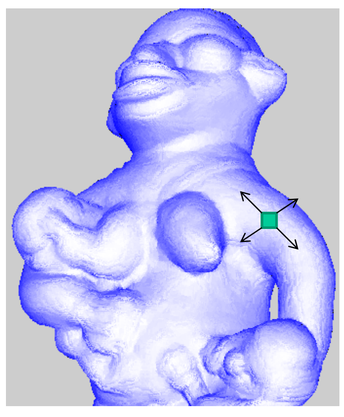
CENTER FOR MACHINE PERCEPTION

CONTRIBUTION

- **Efficient generation of high-quality seed patches**
- **Seed quality measure = sharpness of the objective function**

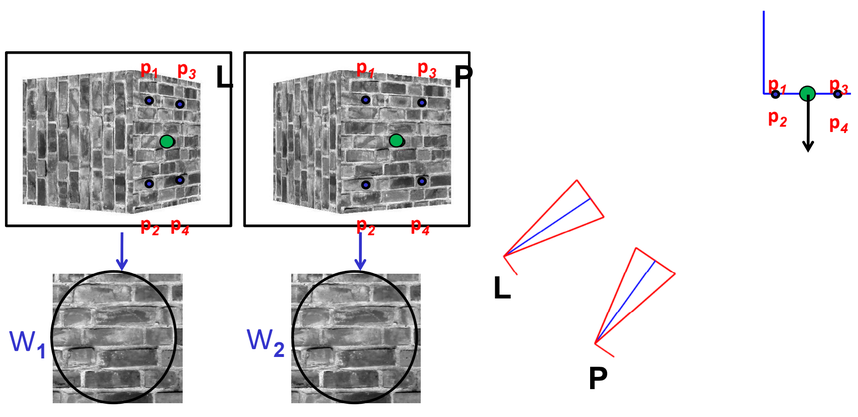
FORMULATION

GOAL



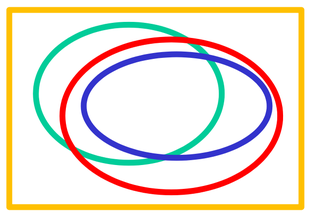
The goal is to generate seeds and grow

APPROACH



The reprojections on the hypothetical planar patch should match. Global optimum over all possible positions and orientations → good seed.

OPTIMIZATION



All possible seeds ⊇ GLOBAL IS BETTER THAN LOCAL

Scene consistent seeds

Globally optimal seeds - ≠ ∅ SCENE CONSISTENCY

Locally optimal seeds ∩

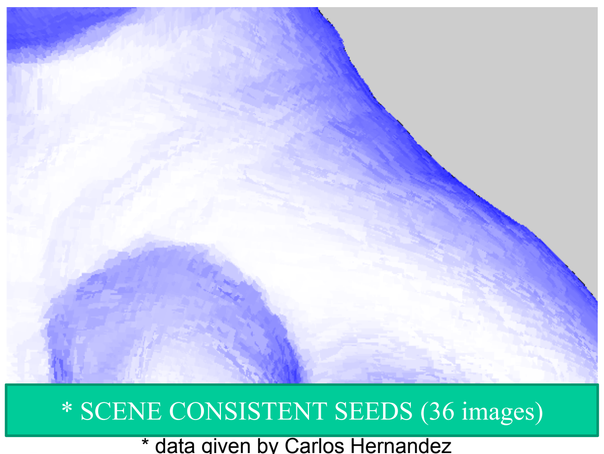
GLOBAL OPTIMALITY PROBLEM

The goal is to find the globally optimal solution

The problem is that exhaustive search is SLOWer than local optimization

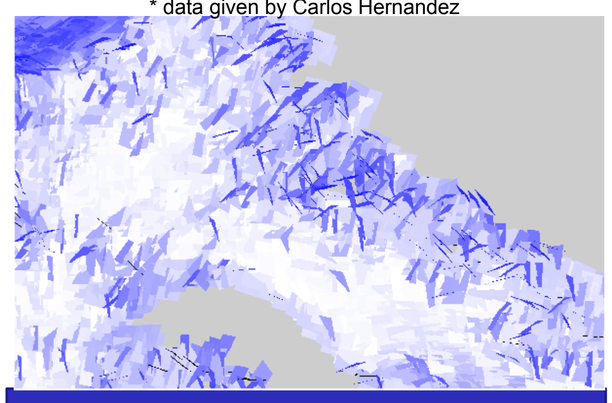
Exhaustive search can be relaxed to speed up the global optimum computation

SCENE CONSISTENCY PROBLEM - ≠ ∅



* SCENE CONSISTENT SEEDS (36 images)

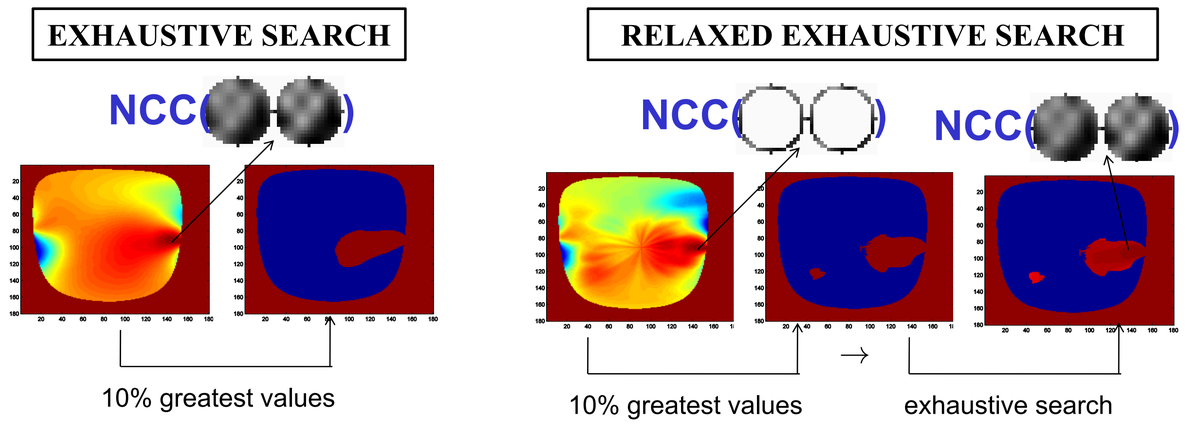
* data given by Carlos Hernandez



GLOBALLY OPTIMAL SEEDS (2 images)

GLOBAL SOLUTION

Based on experiments we decide to relax the exhaustive search as follows



The global optimum was found in 96% of Polynesian and Twins dataset (38527 seeds)

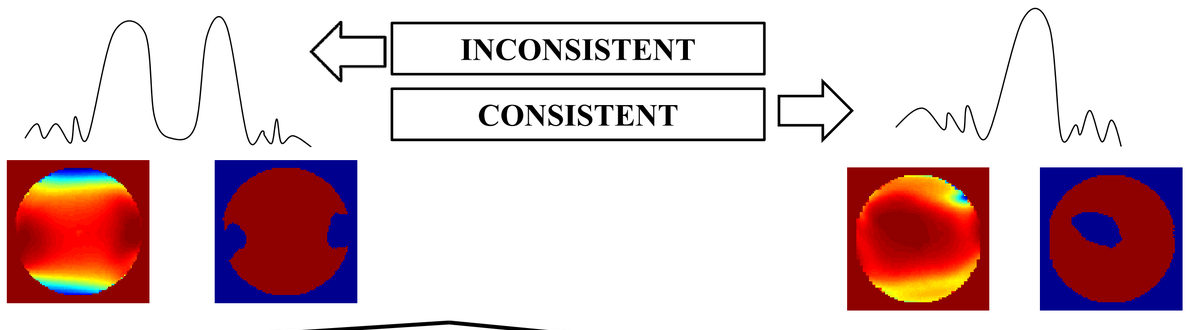
RELAXING THE NORMAL PRECISION

Criterial function "smooth" on the 180x180 discrete parameter space
⇒ search on 60x60 uniformly distributed normals

Degrees precision: $180 \times 180 \rightarrow (\sqrt{2})/2 \approx 0.7, \quad 60 \times 60 \rightarrow (3\sqrt{2})/2 \approx 2$

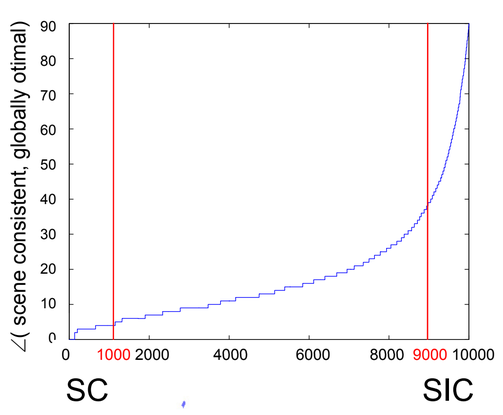
120 TIMES SPEED UP

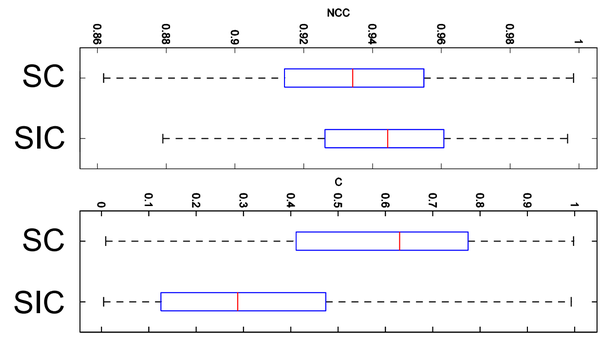
SCENE CONSISTENCY ESTIMATION

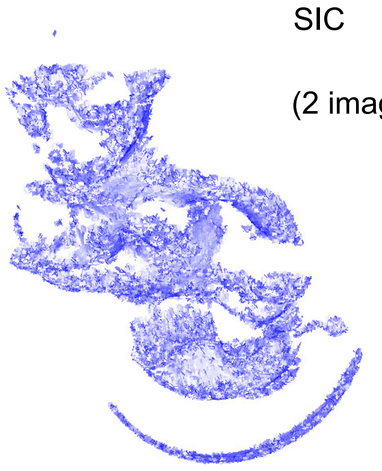


C = [1-(biggest local maximas distance)]*([(global maximum)+1]/2)

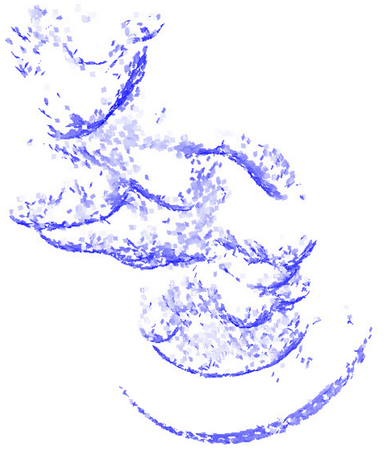
EXPERIMENTS







(2 images)



globally optimal seeds

globally optimal seeds by C