Bayesian Phase Unwrapping with Factor Graphs

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Markov Random Fields and Factor Graphs

Markov Random Field: A particular type of probabilistic model
Factor Graph: a particular language for describing graphical models [**?**]

Factor Graphs for Low-Level Vision

Properties of image MRFs large number of verticies O(1) (constant local) connectivity

MRFs for Phase Unwrapping

Two views on our MRF

Inference in MRFs

Our MRF has given us $p*(x|D)$, which is not convex, and not even a probability distribution.
We would like to somehow "solve" this system to get a rough sense of the distribution $p(x|D)$.
Two generic approaches:

- draw samples from $p(x|D)$
- Try and compute the MAP numerically.

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We focus on sampling.

Markov-Chain Monte Carlo

Remember markov chains from 6.041
Set up a state space so that the expectation is the target distribution Used in situations where you know $\pi^*(x)$ but not $\pi(x)$.

Metropolis Hastings

One way to construct this Markov Chain

$$a = \min(1, \frac{p(x^*)}{p(x)} \cdot \frac{q(x \rightarrow x^*)}{q(x^* \rightarrow x)}) \tag{1}$$

Gibbs Sampling

like MH but along an axis

Tempering

Like Simulated Annealing

Swendsen-Wang

Work Through

MRFs and Parallelism

2-D Synthetic Data

3-D Synthetic Data

Div and Audrey

PRELUDE

Where to now?

Exact sampling using Systematic Stochsatic Search Better neighborhood connectivity / likelihood? GPU implementation Better visualization of posterior?