

MFA for constrained optimization

- Mean field annealing
- Overviews
- Graph bisection problem
- Traveling salesman problem

Peterson & Soderberg

- [Carsten Peterson – Homepage](#)
- Mean field annealing
- Hopfield Neural Networks

MFA for constrained optimization

Problem modeling

A mathematical framework

- An objective function
- Constraints

Energy function

Drive an discrete energy function

Mean field equations

Interactive dynamics for
minimizing the energy function

Software or hardware
implementation

Graph bisection

- mean field annealing
- MFA Optimization

[JM Wu, MFA Optimization For Graph Bisection Problem](#)

Travelling Salesman Problem

□ MFA optimization

[PottsTSP.pdf](#)

JM Wu, Potts models with two sets of interactive dynamics

Traveling salesman problem

- Mean field annealing
 - Spin models (Hopfield & Tank)
 - Potts models (Peterson & Soderberg)
- Simulated annealing (Kirkpatrick)
- Elastic ring (Durbin & Willshaw)
- Self-organization (Kohonen)

Fundamental tasks

- Combinatorial Optimization
 - Graph bisection
 - Traveling salesman problem
 - Scheduling
- Unsupervised learning
 - Clustering analysis
 - Principle component analysis
 - Self-organization
 - Kohonen Self-organization Map
 - Elastic nets

Fundamental tasks

- Supervised learning
 - Classification
 - Function approximation
 - Recursive function approximation
- Independent component analysis
- Blind source separation
- Density estimation and conditional density estimation

Integer Programming

- Integer programming
 - Discrete variables
 - Methods: Mean field annealing, simulated annealing

Unconstrained optimization

- Continuous variables
- Gradient based approaches:
 - gradient method
 - Newton method
 - Newton-Gauss method
 - Levenberg-Marquardt method

Mixed integer programming

- Continuous and discrete variables
- Method:
 - A hybrid of mean field annealing and gradient descent method
 - Free-energy based learning
 - Annealed Free-energy based learning

Hopfield Neural Networks

- Solving Combinatorial optimization
- Methods
 - mean field annealing

Multilayer Neural Network

- Fundamental Tasks
 - Data driven classification
 - Data driven function approximation
- Methods
 - Gradient method
 - Newton-Gauss method
 - Leveberg-Marquardt method

Free Energy Based Approach

