RUTGERS Aresty Research Center for Undergraduates



Main Problem and Importance

Many problems fall into two categories: 1. What will be the effect given some cause?

2. What was the cause given some effect?

This project is concerned with #2.

Main Problem

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Concretely, we deal with inverting the heat diffusion equation, which is to find the quantity and the location of the sources of heat given observations of the heat over time.

But this doesn't need to only be for heat; it can be for in general anything that diffuses.

Importance

This has many applications. For example:

- Finding Sources of Pollution
- Finding Locations of Oil Wells
- Whatever Other Uses

Current Solution and Drawbacks

This problem is solved with simulation.

The idea is to have a list of possible causes and simulate their effects, to find which cause produces effects that most matches our observed results.

Drawbacks

Suppose each cause was a list of values; the set of possible causes quickly becomes prohibitively large as the list gets longer.

It takes time to simulate the effects of a single cause.

These two drawbacks together places limits on our accuracy and speed to simulate complex problems.

New Solution and Advantages

Based on D-Wave's quantum computing architecture, which allows for a technique known as quantum annealing.

The gist is that every possible input configuration can be run in true parallellism.

polynomial.

Inverting the Diffusion Equation with Quantum Annealing Mingyao Xiao



The running time per accuracy tolerance is theoretically unknown for quantum annealing problems, but is a probably a function of space requirements. However, the running time can be set to any amount you desire, just that the results may not be completely accurate. Usually, problems are solved under a minute, and exponential problems usually become

Possible Improvements: - Get a sense of nature of running time of D-Wave systems and of quantum annealing in general via numeric experiments.



3. Numeric Cell

6. Conformity to Real Data

Future Directions

Assumptions made:

- Pollution is dumped once and
- instantaneously.