
CIS 510 FINAL PROJECT

PREDICTING ATOM POSITIONS USING MACHINE LEARNING ALGORITHMS

Project Team:

Adam Martini

Wes Erickson

Ran Tian

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Executive Summary

The Steck Lab is investigating the motion of a single atom in a Magneto Optical Trap (MOT). The atom is imaged using a pair of aspheric lenses and a CCD camera. Given an 2D image from the CCD, the lab wants to predict the probability distribution of the atom's location within the MOT.

1 Project Description

To tackle this problem we will run simulations of the CCD output for a given atom location by solving the linear wave equation using a Partial Differential Equation (PDE) Solver. The output images will be labeled by atom location and used as training set for machine learning algorithms. The algorithms can then be used to generate a probabilistic distribution for the atom's location for a new CCD image.

2 Highlevel Architecture

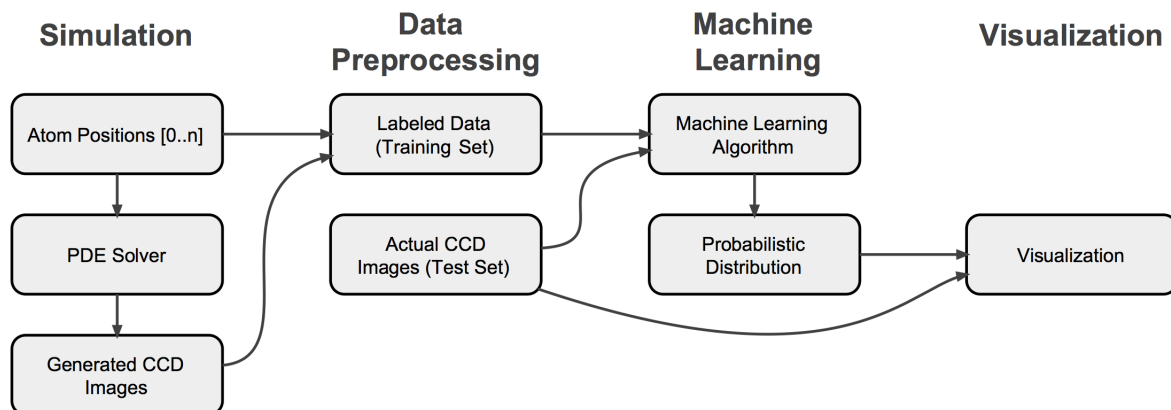


Figure 1: High Level Data Flow Architecture Diagram

Figure 1 shows a block level diagram of the project data flow. There are three main components to the solution.

Simulation

Machine Learning Tr

Visualization

2.1 Simulation

2.2 Machine Learning

We will train and test multiple machine learning algorithms on the simulated images by splitting the training data into a training and validation set. The validation set will be used to determine the best algorithm for this application and then to tune its parameters.

2.3 Visualization

2.4 Data Format

The data will be formatted in the standard Visualization Tool Kit (VTK) format. We will use a regular rectangular structured grid.

3 Parallel Plan

Each stage of the project data flow includes several places to introduce and explore parallelism.

Simulation PETSc...

Machine Learning Which algorithms and how...

Visualization Visit, paraview...

4 Project Schedule

Week	Deliverable
5	Petsc PDE solver installed and running data runs, identify parallel classifiers and get them running
6	Get classifiers working on acciss and extend/create code based on prediction goals.
7	Process initial Petsc output to identify best classifiers.
8	
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10	