Data Point Extraction From Test Figures

Wen-Yi Yen
wyen@stanford.edu

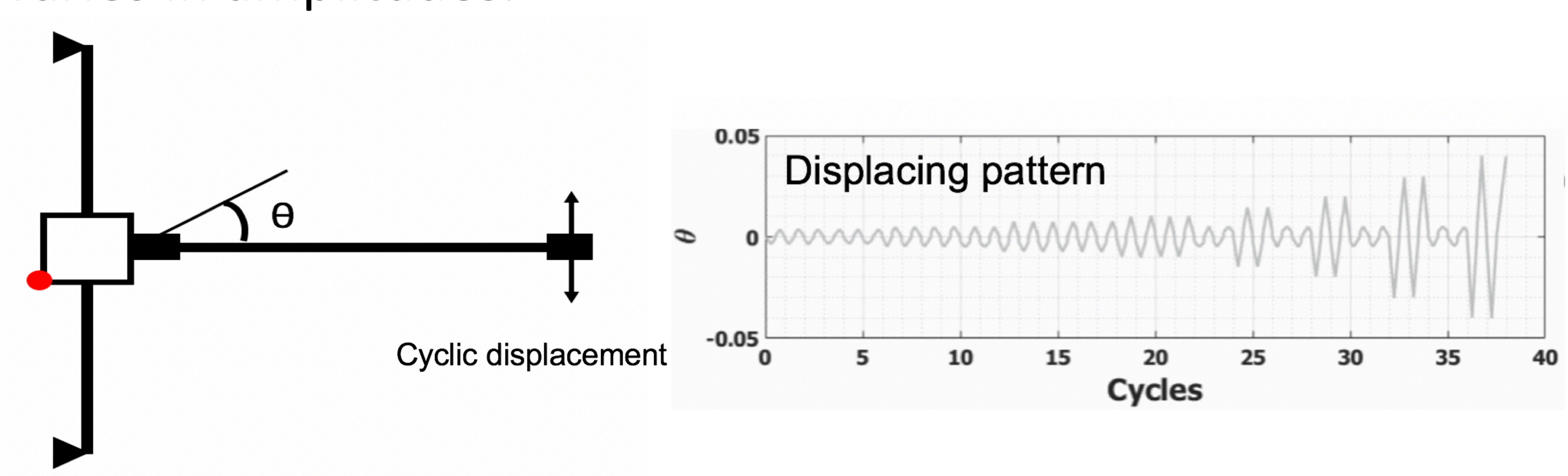
DESCRIPTIONS

Studies in the field of structural engineering relies heavily on the component tests in labs in order to simulate structural behaviors in larger scales. Research relies on past experimental data, which is sometimes could only be found on the old printed papers. Most of the time the tests are carried out under specific sequential pattern, making it harder to retrieve data. Thus, it would be helpful to create an automated tool that reads data points from old, noisy (or stained) figures.

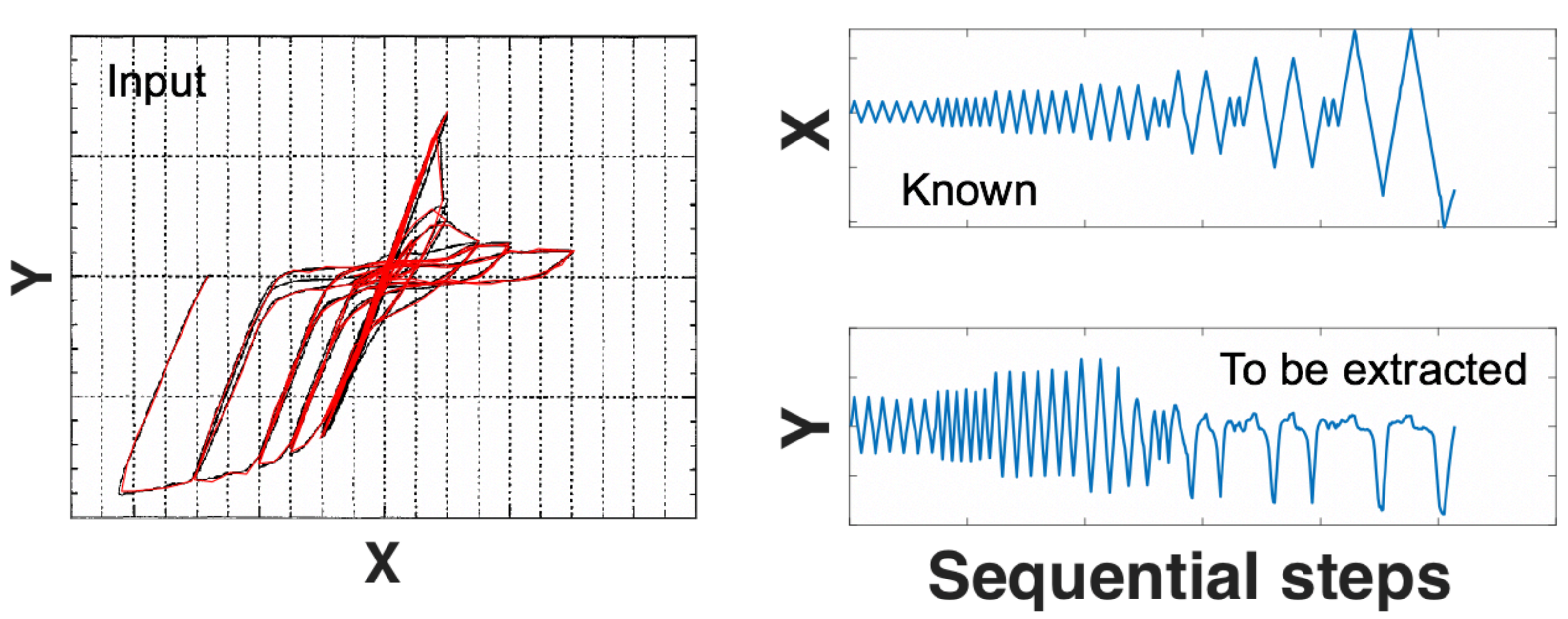
PROBLEM STATEMENT

Component Cyclic Tests

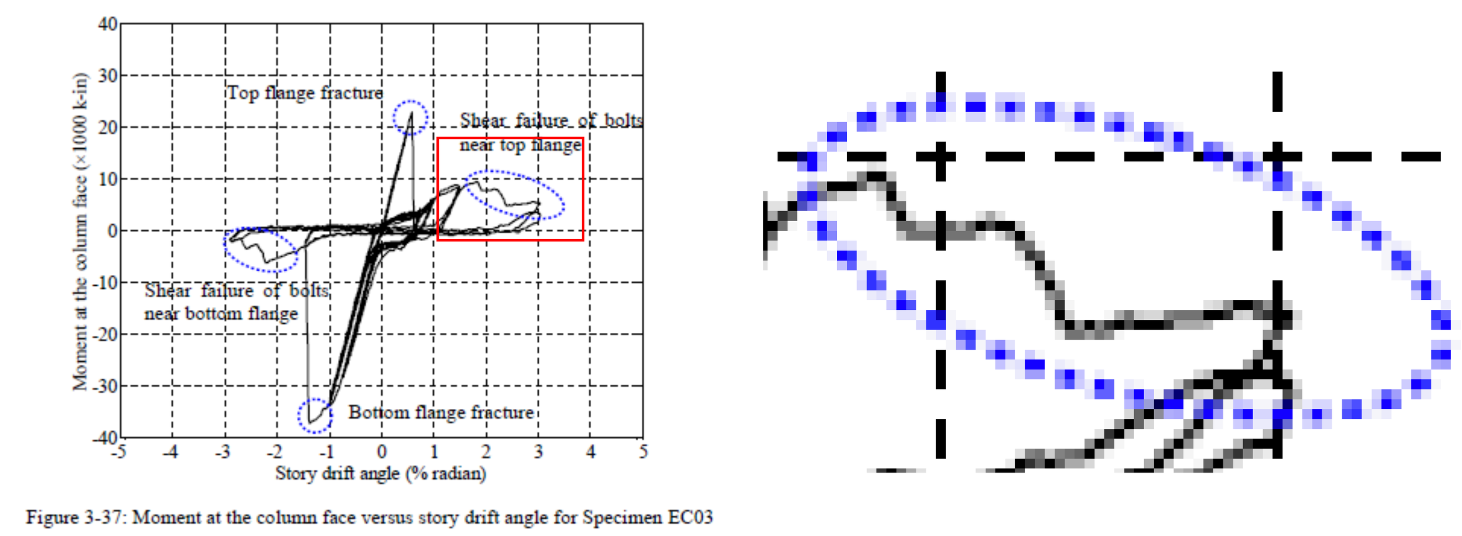
In this project, we are interested in building an auto-read software that extract data from component cyclic tests, which follows specified back-and-forth displacements that varies in amplitudes.



To illustrate the task clearly, the figure contains sequential X-Y data information, in which the X values are known since the experiments are designed with targeted X (cyclic displacements). Then, our goal would be to extract the Y values.



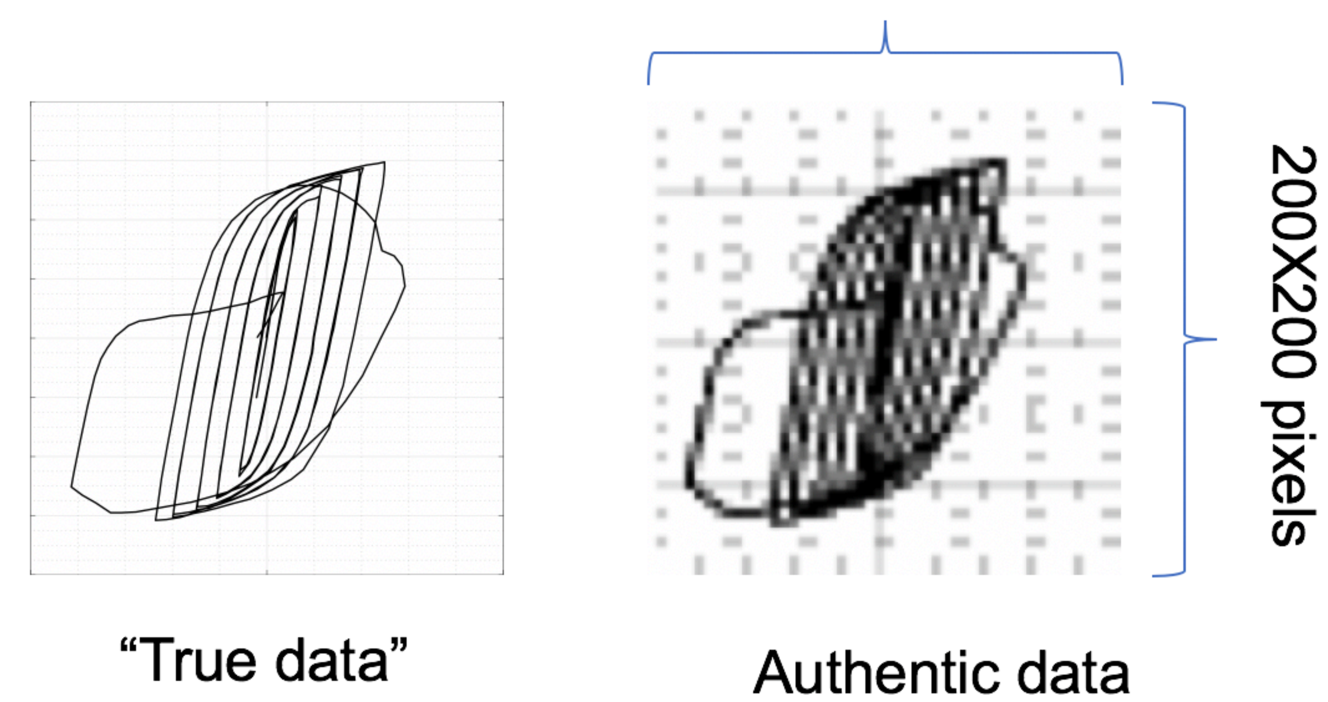
CHALLENGES



The major challenges of tracking the correct path sequences are: (1) line crossings appear frequently; (2) some annotations were made; (3) rigid grid lines were often used in the old experiment figures. Normally, the data points are extracted manually with human judgements, which takes time and process could be dry.

GENERAL APPROACH

Data Authentication (Fake Old Figures)

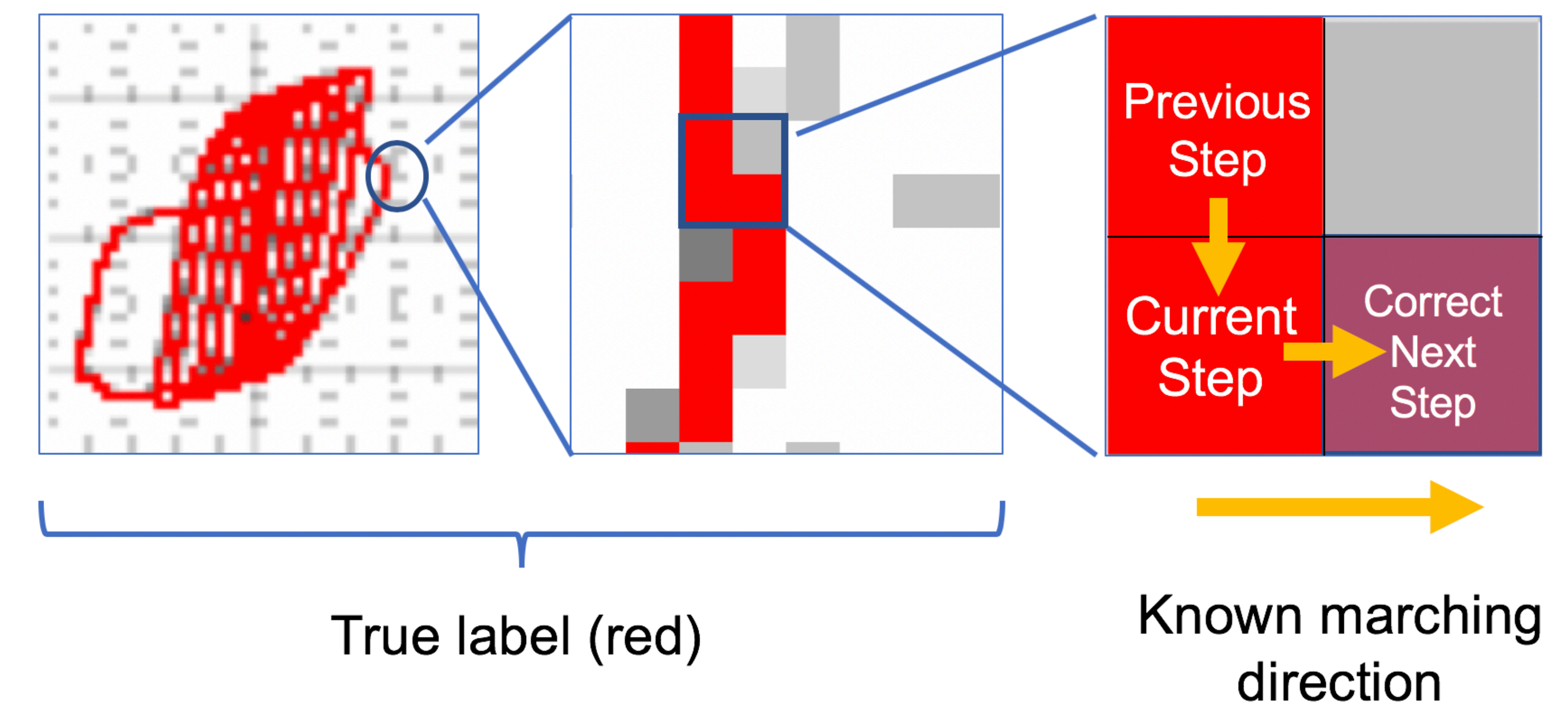


To approach the task, we collected around 300 tests with manually extracted data points. The task includes generating true labels from those data points, and they are also used to produce authentic "old images".

The authentic figures are generated as **200X200 pixel** graphs to resemble the blury-ness of old images. To generate more challenging tasks, darker grid lines and reasonable markings are added, which most real test images could possibly contain.

PRELIMINARY RESULTS & DISCUSSION

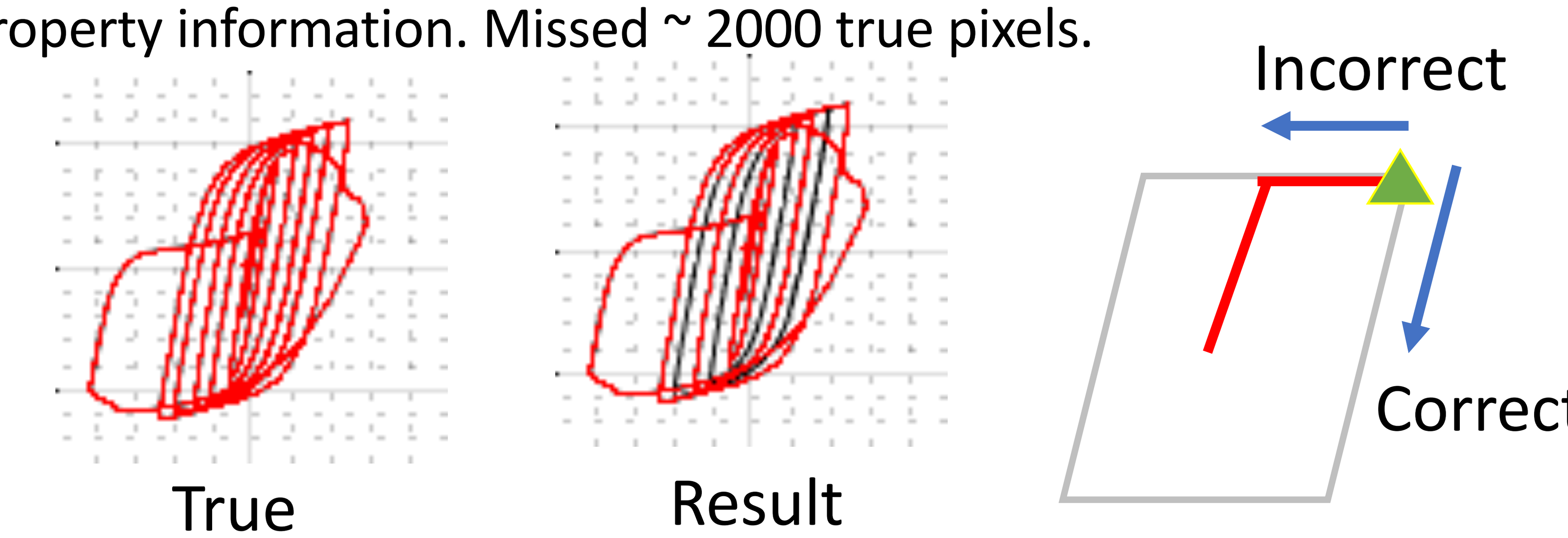
Pixel Marching Method



With a given starting point (pixel) on an image and the known marching direction, we guess the most probable next data pixel, and so on, as demonstrated in figure above. The true labels are designed as a series of pixels next to one another, which helps simplify the problem statement of "optimal path search".

Dynamic Programming

The task could intuitively be modeled as a search algorithm, which the cost ***Cost(s; a)*** is related to the darkness of the color pixel . The result shows that the cost function itself cannot capture the material property information. Missed ~ 2000 true pixels.



ON-GOING WORK AND IMPROVEMENTS

$$Q_{opt}(s, a; \mathbf{w}) = \mathbf{w}\phi(s, a)$$

In this case, Q-learning with function approximation best suits our needs as we can formulate the feature factor $\boldsymbol{\phi}(s; a)$ to related to the human judgements that is important when (1) the path is related to material information; (2) there are crossings in the images.