Automated Screening of Sonar Imagery using Artificial Techniques

John Tran
Computer Systems Lab 2009-2010

Abstract

Sonar operators can determine the signals of interest from sonar imagery visually. However, sonar imagery is plagued with unwanted noise from other irrelevant sources, making detection of signals of interest much more time-consuming. Application of neural networks for pattern recognition is useful in addressing this optimization issue. Modifying the neural network with other techniques and algorithms and using processed image data instead of raw sonar data will refine the overall results. By using a program to incorporate all of this to remove unwanted noise from the image, sonar detectors can spend less time analyzing the sonar image for signals of interest.

Background and Introduction

The purpose of this project is to apply neural networks with modifications to address this detection problem, with the intention of reducing the time needed for sonar detectors to analyze the sonar image. The extent of this project is limited specifically to sonar operators; however, its application can be used as a stepping stone to other future research projects.

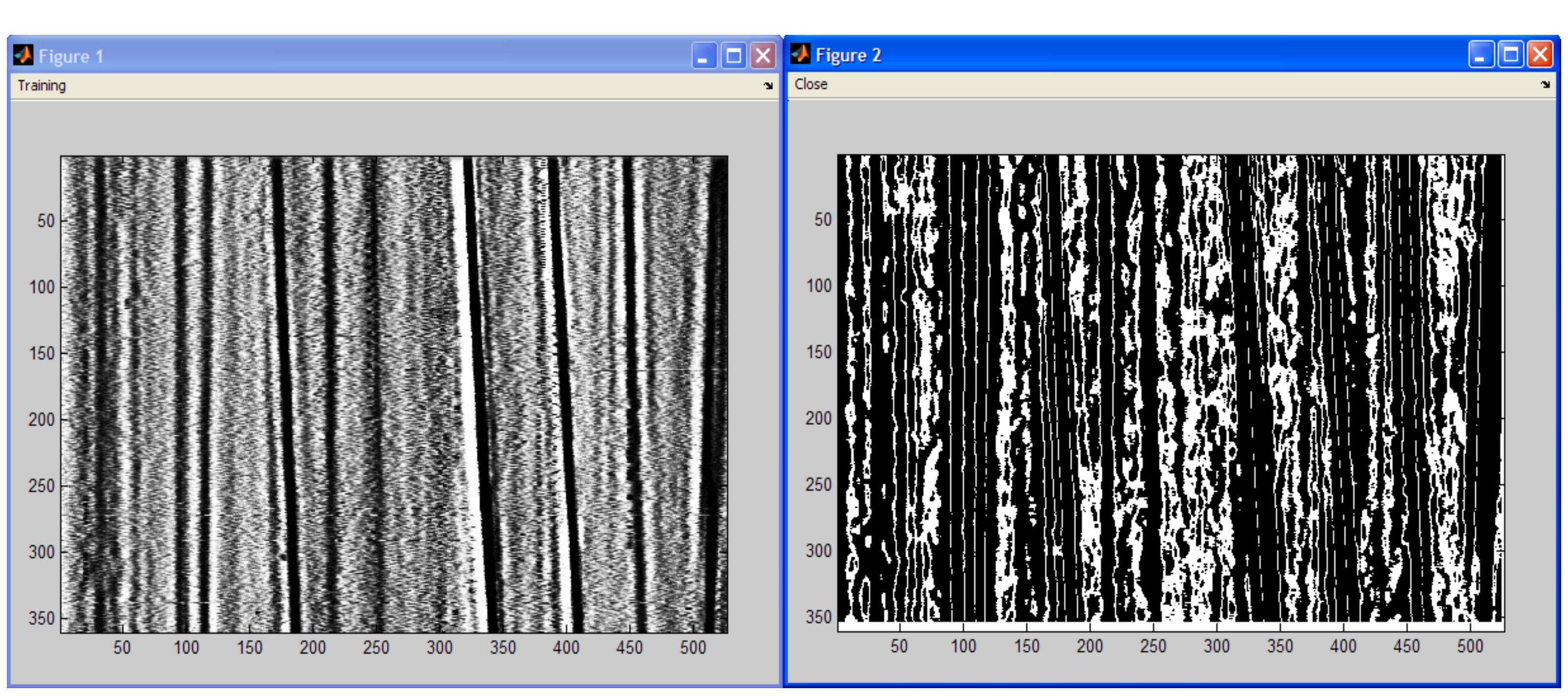

Figure 1. Comparison of the original sonar image and the detection space output. The detection space output is a collection of the pixels in the sonar image that have went through the neural network. My intention is to replicate the original sonar image, with the noise whitened out.

Discussion

Three types of testing exist for this test: visual testing, statistical testing, and back propagation testing, which is partially linked with statistical testing. In visual testing, the original image is compared with the detection space output. In statistical testing, the image statistics and the back propagation are tested for accuracy. In back propagation testing, the neural network is tested to see how well it can train when few incorrect training data along with correct training data is used. Incorrect training data would be setting a pixel of noise to "Interesting" or setting a pixel in a signal of interest as "Not interesting".
Additional testing was done at an earlier stage for image statistics. Each image statistic had a matrix representation. The matrix representation was plotted as a color graph and was checked to see if the graph looked similar to the original sonar image. A similarity between the two ensures correct image statistic calculation.

Results and Conclusions

Expected Results:
Initially, the neural network should perform somewhat optimally, as the weights were initiated with the idea that error would be mostly reduced. As time progresses, at the end of the training, the error should decrease significantly, into the .001 to .01 range.