

6th Quarterly Report – Public Page

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Prepared for: *Department of Transportation/Pipeline and Hazardous Materials Safety Administration*

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Prepared by: *Physical Sciences Inc.*

Contact Information: *Mickey Frish, frish@psicorp.com, (978) 738-8252*

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Public Page Section –

Work Completed During this Quarterly Period

Previously, we described results of utilizing the self-learning abnormality algorithms to post-process data collected during several weeks of on-site field tests. An objective of this project is to implement these algorithms to process data in real time. To achieve real-time processing, PSI modified its feature extraction subroutine in the self-learning algorithm to reduce the dimension of the feature space without losing important information. Dimension reduction was achieved by implementing a principal component analysis (PCA) subroutine. PCA is applied to help optimize the feature array and to discard less significant features. It transforms a number of potentially correlated variables (features) into a number of relatively independent variables that are ranked according to their contributions for explaining the whole data set. The first principal component (transformed variable) accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible. In addition to dimension reduction, PCA facilitates k-means classification to find near-optimal solutions, as it automatically projects to the subspace where the global solution of k-means classification lies.

Also during this period, fabrication of next-generation hardware for the field tests also progressed at Heath Consultants. Previously, PSI built and delivered sensor elements to Heath. Heath has now fabricated circuit boards, support structures, housings, solar power sources, and communications components that will be integrated into a new installation configuration. Engineering ~~t~~This new configuration has delayed the planned field tests.

General Information required on all Public Quarterly Reports

Results and Conclusions:

Figure 1 shows the updated algorithm flowchart. The new algorithm is able to reduce 24 extracted features down to 2 principal components, which are then sent to the *k*-means clustering subroutine. This leads to a clustering result of only 2 clusters, which significantly reduces the computational time.

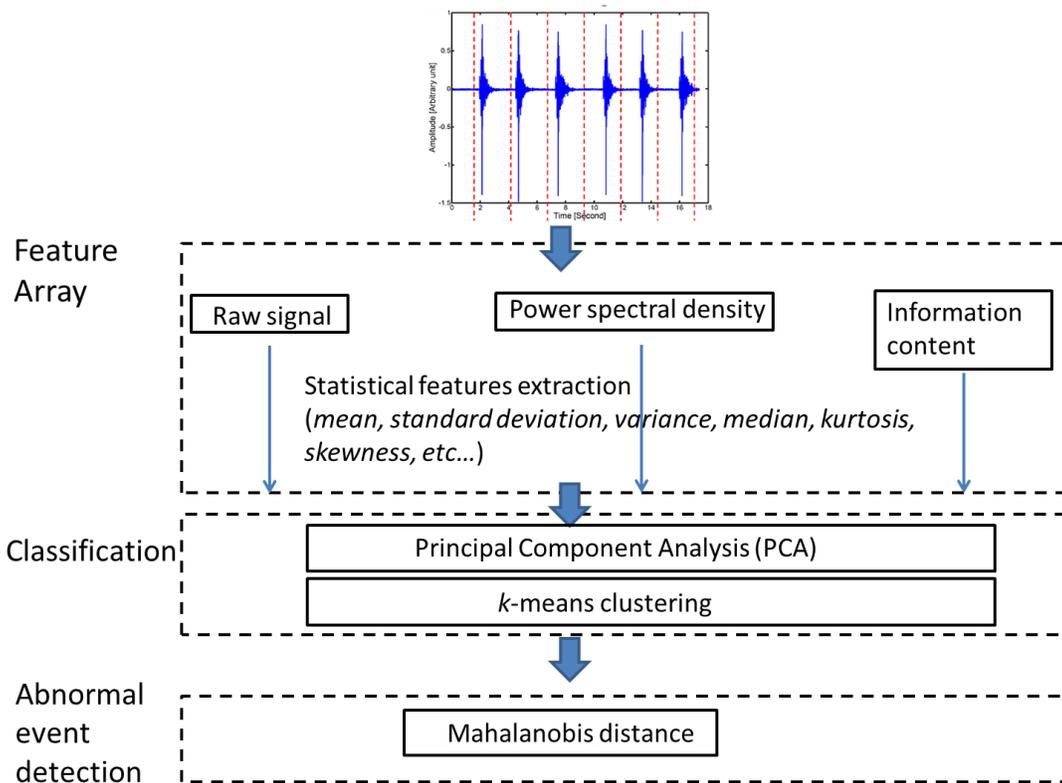


Figure 1. Flowchart of modified self-learning algorithm. The new algorithm reduces the number of features without loss of information.

Plans for Future Activity:

PSI, with cost share and product development partner Heath Consultants, are progressing with sensor assembly. Additional testing of the updated algorithms by post-processing data previously gathered is envisioned for next quarter. The initial field test using the new algorithms installed on new sensors is planned for the following quarter.