



Recognition Toolkit

Tools for Object Recognition and Classification

Recognition Toolkit, developed by Recognition Science, Inc., extends Aphelion™ Developer with a broad set of tools for object recognition and classification. This optional module uses probabilistic analysis and information measurements to automate the development of classifiers. Probability and information based classifiers can be generated automatically, freeing the user from the necessity of specifying complex rules for object recognition. These tools can be used either to process Aphelion™ ObjectSet data or standard scalar datasets. Example macros are provided and can be directly employed or used as templates.

EXTEND APHELION™ DEVELOPER'S CAPABILITIES FOR:

- ✓ Pattern recognition
- ✓ Automatic classification
- ✓ Statistical classification
- ✓ Feature analysis and evaluation

Recognition Toolkit provides the user with the ability to perform pattern recognition on continuous measurement data, discrete data, or symbolic information. It contains a series of operators for classification, training, feature evaluation, cluster coding and extraction. Twenty operators form the pattern recognition core of the Recognition Toolkit for the Aphelion™ System, and five additional advanced extraction and demonstration operators assist in the development of complex recognition algorithms. The core operator set includes classifiers, training operators, an automatic natural clustering routine, feature evaluation and analysis operators, and utility operators for preprocessing and building user defined classifiers. A complete alphabetical operator list and description is provided in the table following below (reverse side).

Recognition Toolkit:

- High-level module for probabilistic classification
- Powerful set of tools for advanced Image Understanding through the use of ObjectSets and the Intermediate Symbolic Representations (ISR) available in Aphelion™ Developer
- Helps to perform high-level classification in the fields of biology and cytology, when cell categories have to be determined based on a large set of measurements and attributes. It can also be applied to robotics applications.

Aphelion™ Recognition Toolkit Operators:

AutoCode

Utility

Automatically codes features to discrete form. The user can select the maximum number of discrete states permitted. (description)

Bayes_Cls

Classifier

This trainer sets up all of the reference data required by Bayes_Cls. This includes generation of class centroids, covariance, and base weights.

Bayes_Trn

Training

Multivariate normal Bayesian classifier for normally distributed measurement data which can produce optimal results when its assumptions are met. Prior class weights can be accepted from the reference file, be set to default values, or adjusted by the user to favor specific classes.

Boxes

Extract

Finds related opposite and adjacent corners for the extraction of rectangular objects.

Centroid

Utility

Given data and labels, this routine computes class centroids in the feature space.

Corners

Extract

Finds corners under user specified tolerances. Uses basic line object input.

CorrEval

Evaluation

Correlation based on feature evaluation. This operator can assist in evaluation of the utility of measurement data and reducing redundancy in a set of features.

DIT_Cls

Classifier

The Discriminant Information Tree (DIT) classifier provides a capability to classify data which is discrete, coded, or symbolic. It can function without any class centroid separability under complex data distributions. Continuous measurement data can be coded for use with this classifier using the AutoCode or Encode operators.

DIT_Trn

Training

This trainer uncovers the optimal discriminant information tree and probability structures for DIT_Cls.

Encode

Utility

Encodes measurement data using specified partitions. The partitions can be from AutoCode or user generated.

FindROI

Extract

This routine detects regions of interest (ROI's) in an image using a K-nearest neighbor algorithm. It can be used for cueing or as the first stage in a multistage classifier.

InfoEval

Evaluation

This tool determines, on a feature-by-feature basis, the best features for class separation. It can be used to evaluate symbolic features, discrete features, and coded measurement data. It provides a measure of the discriminant information in each feature, and automatically rank-orders an output feature set from most powerful to least powerful.

KNN_Cls

Classifier

K-Nearest-Neighbor classifier for utilization on measurement data with complex distributions. This classifier can operate when classes are not easily separable

KNN_Trn

Training

Generates a reference prototype file for the K-Nearest-Neighbor Classifiers of KNN_Cls and FindROI.

LinkEval

Evaluation

Finds tree linkage structure which maximizes second-order discriminant information. Can assist in feature discrimination or redundancy evaluation.

MeanAsgn

Utility

This routine assigns data to closest centroid. Permits rapid evaluation of class separability of user selected or modified centroid values. Can be used with Centroid operator or PFSClust operator to develop alternative classifiers.

MinD_Cls

Classifier

This Minimum Distance Classifier provides an easy to use classification capability with very minimal training data requirements and minimal computational complexity. It assigns samples based on Euclidean distance from class centroids in the feature space.

MinD_Trn

Training

Sets up class centroids and weights for the minimum distance classifier. An excellent tool for the interpretation of measurement data from well separated classes.

MRegres

Evaluation

This Multiple Regression analysis technique computes the optimal linear combination of features to estimate an outcome. It can be used in feature evaluation and redundancy analysis.

Normal

Utility

Generates normalized features by extracting the mean and standardizing variances to one. Eliminates measurement unit scaling effects in data.

PairEval

Evaluation

Computes pairwise discriminant information. It provides a measure of how well each pair of features can be used to predict the correct class label. It can also help identify redundant features in a selection of discriminant feature sets.

Parallels

Extract

Finds parallel line pairs under user specified control of separation distance ranges and degree of overlap. Uses line object input.

PFSClust

Clustering

Pseudo F-Statistic (PFS) Clustering finds the natural classes in a set of data. This unsupervised classification algorithm can be used to automatically find natural separations in the feature space. It can guide in feature selection and class definition for a later classifier implementation.

WinFeats

Extract

Produces window based features useful for detection and classification. It supports FindROI in detection of regions of interest. Window size and overlaps are selected by the user.