!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!IMPORTANT!!!!!!!!!!!!!!!!!!!!!!!!!!!!

 This dataset comes from the Turing Institute, Glasgow, Scotland.

 If you use this dataset in any publication you must acknowledge this

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NAME

 vehicle silhouettes

PURPOSE

 to classify a given silhouette as one of four types of vehicle,

 using a set of features extracted from the silhouette. The

 vehicle may be viewed from one of many different angles.

PROBLEM TYPE

 classification

SOURCE

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HISTORY

 This data was originally gathered at the TI in 1986-87 by

 JP Siebert. It was partially financed by Barr and Stroud Ltd.

 The original purpose was to find a method of distinguishing

 3D objects within a 2D image by application of an ensemble of

 shape feature extractors to the 2D silhouettes of the objects.

 Measures of shape features extracted from example silhouettes

 of objects to be discriminated were used to generate a class-

 ification rule tree by means of computer induction.

 This object recognition strategy was successfully used to

 discriminate between silhouettes of model cars, vans and buses

 viewed from constrained elevation but all angles of rotation.

 The rule tree classification performance compared favourably

 to MDC (Minimum Distance Classifier) and k-NN (k-Nearest Neigh-

 bour) statistical classifiers in terms of both error rate and

 computational efficiency. An investigation of these rule trees

 generated by example indicated that the tree structure was

 heavily influenced by the orientation of the objects, and grouped

 similar object views into single decisions.

DESCRIPTION

 The features were extracted from the silhouettes by the HIPS

 (Hierarchical Image Processing System) extension BINATTS, which

 extracts a combination of scale independent features utilising

 both classical moments based measures such as scaled variance,

 skewness and kurtosis about the major/minor axes and heuristic

 measures such as hollows, circularity, rectangularity and

 compactness.

 Four "Corgie" model vehicles were used for the experiment:

 a double decker bus, Cheverolet van, Saab 9000 and an Opel Manta 400.

 This particular combination of vehicles was chosen with the

 expectation that the bus, van and either one of the cars would

 be readily distinguishable, but it would be more difficult to

 distinguish between the cars.

 The images were acquired by a camera looking downwards at the

 model vehicle from a fixed angle of elevation (34.2 degrees

 to the horizontal). The vehicles were placed on a diffuse

 backlit surface (lightbox). The vehicles were painted matte black

 to minimise highlights. The images were captured using a CRS4000

 framestore connected to a vax 750. All images were captured with

 a spatial resolution of 128x128 pixels quantised to 64 greylevels.

 These images were thresholded to produce binary vehicle silhouettes,

 negated (to comply with the processing requirements of BINATTS) and

 thereafter subjected to shrink-expand-expand-shrink HIPS modules to

 remove "salt and pepper" image noise.

 The vehicles were rotated and their angle of orientation was measured

 using a radial graticule beneath the vehicle. 0 and 180 degrees

 corresponded to "head on" and "rear" views respectively while 90 and

 270 corresponded to profiles in opposite directions. Two sets of

 60 images, each set covering a full 360 degree rotation, were captured

 for each vehicle. The vehicle was rotated by a fixed angle between

 images. These datasets are known as e2 and e3 respectively.

 A further two sets of images, e4 and e5, were captured with the camera

 at elevations of 37.5 degs and 30.8 degs respectively. These sets

 also contain 60 images per vehicle apart from e4.van which contains

 only 46 owing to the difficulty of containing the van in the image

 at some orientations.

ATTRIBUTES

 COMPACTNESS (average perim)\*\*2/area

 CIRCULARITY (average radius)\*\*2/area

 DISTANCE CIRCULARITY area/(av.distance from border)\*\*2

 RADIUS RATIO (max.rad-min.rad)/av.radius

 PR.AXIS ASPECT RATIO (minor axis)/(major axis)

 MAX.LENGTH ASPECT RATIO (length perp. max length)/(max length)

 SCATTER RATIO (inertia about minor axis)/(inertia about major axis)

 ELONGATEDNESS area/(shrink width)\*\*2

 PR.AXIS RECTANGULARITY area/(pr.axis length\*pr.axis width)

 MAX.LENGTH RECTANGULARITY area/(max.length\*length perp. to this)

 SCALED VARIANCE (2nd order moment about minor axis)/area

 ALONG MAJOR AXIS

 SCALED VARIANCE (2nd order moment about major axis)/area

 ALONG MINOR AXIS

 SCALED RADIUS OF GYRATION (mavar+mivar)/area

 SKEWNESS ABOUT (3rd order moment about major axis)/sigma\_min\*\*3

 MAJOR AXIS

 SKEWNESS ABOUT (3rd order moment about minor axis)/sigma\_maj\*\*3

 MINOR AXIS

 KURTOSIS ABOUT (4th order moment about major axis)/sigma\_min\*\*4

 MINOR AXIS

 KURTOSIS ABOUT (4th order moment about minor axis)/sigma\_maj\*\*4

 MAJOR AXIS

 HOLLOWS RATIO (area of hollows)/(area of bounding polygon)

 Where sigma\_maj\*\*2 is the variance along the major axis and

 sigma\_min\*\*2 is the variance along the minor axis, and

 area of hollows= area of bounding poly-area of object

 The area of the bounding polygon is found as a side result of

 the computation to find the maximum length. Each individual

 length computation yields a pair of calipers to the object

 orientated at every 5 degrees. The object is propagated into

 an image containing the union of these calipers to obtain an

 image of the bounding polygon.

NUMBER OF CLASSES

 4 OPEL, SAAB, BUS, VAN

NUMBER OF EXAMPLES

 Total no. = 946

 No. in each class

 opel 240

 saab 240

 bus 240

 van 226

 100 examples are being kept by Strathclyde for validation.

 So StatLog partners will receive 846 examples.

NUMBER OF ATTRIBUTES

 No. of atts. = 18

BIBLIOGRAPHY

 Turing Institute Research Memorandum TIRM-87-018 "Vehicle

 Recognition Using Rule Based Methods" by Siebert,JP (March 1987)