

1.1 Exercises

Explain the following concepts.

Low-level vision, intermediate-level vision, high-level vision.

Solution.

The first level is called low-level vision (LLV). LLV is related to local properties concerned with continuity or discontinuity of intensity, texture, or color. Noise reduction, smoothing, contrast enhancement, edge detection, and thresholding methods fall into the category of low-level vision. These image processing methods are often general and can be applied to a variety of different image classes. This processing could determine features at each point such as the edge properties, texture properties, or surface normals for 3-D imagery.

Intermediate level vision is concerned with integrating local or point features into global constructs or regions. Examples would be edge point aggregation into lines and point aggregation into regions. This relates to image partitioning or segmentation into regions that perceptually relate to objects in the image. Typical models here are lines, parallel lines, perpendicular lines or polygons that represent simple geometric objects such as roads, doors, and buildings that commonly occur in scenes.

High-level vision (HLV) utilizes higher levels of processing and more complex object relationships in the modeling of objects. For example, processing methods might involve formal logic, constraint programming, rules, frames or other artificial intelligence programming methodologies. There is a more complex knowledge representation. Inferencing is involved in scene interpretation. The vision system has more semantic content and therefore the software is more specifically tailored to the specific image class. This corresponds to the more cognitive levels of image interpretation by humans.

1.2 Exercise

The domains related to the computer vision problem.

Solution.

The world domain is the actual physical world of 3-dimensional objects. In every situation one has an understanding of the objects. Examples in aerial scenes would be cars, roads, houses, etc. Objects in turn may be composed of surfaces. An example would be a car with the different surfaces such as fenders, hood, etc. A surface is characterized by a change in the 3-d representation of an object. e.g. plane to sphere.

Another domain is the image domain The Image data obtained from the camera and data acquisition system. The light source, the world domain, and the camera system affect these data. These are the data our processing systems operate upon. The image domain data may be 2-dimensional or 3-dimensional. There may be many different types of data available such as reflectance data from different spectral bands; thermal data, range data, radar data. We make measurements in the image domain on pixels, patches or regions. Examples would be gray level of a pixel, the average gray level of a region, or the area of a region.

The scene domain consists of the representations or models of the physical objects in the world domain. Examples would be a road modeled as a linear element which is white or black in color or has a given spectral response. Another example would be a house modeled as composed of rectangles. Each object must have a description of the 3-d object in the world domain it

represents. The object models in the scene domain are often called a world model. One interprets the image data according to the objects in the scene domain.

Another domain is the processing or computational domain. This domain consists of the collection and organization of the software that performs the analysis and interpretation of the image data. Examples would be edge detectors, region formation methods, line followers, or texture analysis methods. This domain reflects the manner in which the software is structured and interacts with the image domain and scene domain