Abstract

Extraction of Light Sources from Night Imagery

At present, training simulators employ geotypical imagery for night training. In addition, light sources can be rendered, but these are often placed in a geotypical manner, unless considerable manual effort is expended. As a result, the scene displayed in the trainer does not contain the actual light sources present in the real world. This data would be of considerable value for mission rehearsal applications, permitting the planning and practice missions in unfamiliar areas at night.

If night imagery is available for a specific geographic area, then it is possible to extract the locations, elevations, and type of light source from the imagery. This imagery can be in either the visual spectrum or the infrared portion of the electromagnetic spectrum. Generally the latter is called aerial infrared thermography and consists of 2D top-down images. These images can be overlapping, thereby providing the capability to determine elevations of light sources using parallax. In some cases, visual imagery is available in the form of oblique images. These images can provide elevations in even greater precision.

As a caveat, night imagery may not always be readily available. Given the expense of aerial or satellite imagery, resources have in the past been directed towards obtaining daylight imagery. Satellites are often kept in synchronous orbit, and turned off at night. But as interest in the use of night imagery grows, more assets will be directed towards its acquisition.

Extraction of light sources from imagery employs computer vision. This extraction starts with identification of pixels in an image that might belong to a light source. Generally these are the brightest pixels in an image. Selection of a range of intensities is required to isolate the desired pixels in the image. Once the desired pixels have been obtained, these must be assigned to regions or patches. It is these patches that are identified as possible light sources. Algorithms need to be developed that determine which of the candidate patches is indeed a light source.

Once light sources have been identified, their locations can be obtained easily if the images are georeferenced. Determination of the elevations of lights sources is more involved. Overlapping images of the same light source are required to permit the use of parallax to determine the distance of the light source from the aircraft mounted camera. Once this distance is obtained, knowledge of the aircraft elevation can then be used to obtain the elevation of each light source.

The color of the light sources can be determined if color imagery is available. It is possible to extract the color of each light source and its type, such as mercury vapor, sodium vapor, or incandescent. If there are an adequate number of images of a light source with the times the images were made, then a light of variable intensity, such as a blinking light, can be identified with its periodicity.

The results of the extraction can be saved in open standard database formats, such as SHAPE files. These databases can then be readily available for a wide variety of simulators or other applications that may require such data. These include military and non-military training, municipal planning, nighttime power usage surveys, and homeland security.

Updates to databases can be made much more quickly and less expensively than by manual effort. Prototypes of software of this type of extraction can permit regeneration of databases for a given area in minutes or even seconds.

In summary, the technology exists to exploit night imagery for the creation of databases of light sources useful for a wide variety of applications.