Deepening our understanding of cognitive aspects of image analysis: Relationships between medical image processing and earth observation

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Broadly speaking, remote sensing is considered the measurement of an object from some distance. Both medical image processing and satellite-borne remote sensing fit within this definition while focusing on different features at different scales. In both cases, human analysts acquire information beyond their visual abilities using electromagnetic radiation. Medical imaging plays an important role in the healthcare industry, from radiological x-rays to mammography, for diagnostic and long-term health monitoring. Remote sensing in the spatial sciences refers to the use of satellite or airborne sensors capturing electromagnetic radiation reflected or emitted from the earth's surface for the detection and attribution of patterns in images. Synergies of approaches developed within both of these domains can be used to inform the development of novel methodologies useful for general understanding of visual perception and expertise, as well as, deepen our understanding of the perceptual and cognitive processes specific to visual analysis. The study reported here provides a comparison of current understandings of the human role in both remote sensing and medical image processing.

The first comparison is made between the process models of image analysis proposed within the domains. Models of medical image processes, including diagnosis, are presented within the medical image processing. Similarly, in remote sensing the models of image interpretation are proposed. Comparisons between the techniques used by human analysts, as well as the objects under investigation are made. Finally, a process model that encompasses aspects of image analysis from both domains is proposed.

A second comparison is then given of the role of cognitive perspective in the design of visual dis-plays in the two domains. The Medical Imaging Perception Society points to the need to understand perception and interpretation of medical images, and improvements to the display of medical images. These two initiatives parallel similar initiatives in GIScience improving understanding of the perception and interpretation of geospatial data, and the development of geovisual analytic techniques and tools for image analysis.

The effectiveness of both medical image analysis and satellite-born image analysis depends on the analysts' knowledge of what to look for and how to identify it, thus on expertise in the domain and in the visual analysis method. Both of these domains face similar cognitive research challenges; visual search object identification; pattern

adfa, p. 1, 2011.

recognition; relating visual attributes to dynamic processes; and the question of data modeling and representation. The synthesis of current knowledge from these domains can advance research efforts for both medical imaging and remote sensing.