

# KNOWLEDGE REPRESENTATION AND EXCHANGE OF VISUAL PATTERNS USING SEMANTIC ABSTRACTIONS

Adrian Barb

Dr. Chi-Ren Shyu, Dissertation Supervisor

## ABSTRACT

Modern technology enables organizations to build large-scale data repositories. The utility of such repositories, however, is limited if they don't support flexible methods of extracting knowledge, especially for image repositories. Existing content-based visual media retrieval systems create models that are often optimized to the domain knowledge provided by experts during training processes. However, most of these systems lack the flexibility to address the gap between computer and human representations of visual patterns.

The scope of this dissertation is to research methods of knowledge exchange in a loosely integrated environment, while preserving the individual characteristics of knowledge representation. For this, we have developed a knowledge repository and exchange framework for large-scale image databases called Essence. This framework facilitates domain knowledge representation by mapping commonly agreed semantics such as ontologies into low-level features using flexible association rules. It also provides novel and efficient methods of exchanging both tacit and explicit knowledge using semantics. This research was applied to modeling the phenotype-genotype correlations of maize mutants (bioinformatics), studying patterns of pulmonary diseases found in high-resolution computed tomography images of lungs (medical informatics), and discovering relevant knowledge from satellite images (geospatial intelligence). Over the past four years, this research has been empirically proven to be valuable in assisting domain experts in their decision making processes. The Essence framework can be valuable for training and decision making and could be the foundation of building a novel and flexible model for visual media retrieval that uses expert defined semantics. With appropriate extensions, this approach can be adapted to other domain specific visual media databases.