Bisque : Bio-Image Semantic Query User Environment

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We describe the design and development of BISQUE – Bio-Image Semantic Query User Environment – a database and analysis infrastructure that is being developed at Center for Bio-Image Informatics. Bisque offers a unique flexible environment for the users to ingest 5-D image and video data/metadata. It provides for powerful image analysis, pattern recognition, database search and querying, and easy sharing and collaboration among researchers.

While generic image databases have been studied and extensively deployed, image and experimental metadata has emerged as the key to understanding and sharing of images. Imaging metadata (data associated with the actual imaging such as light source, image planes, etc) has been in addressed in systems like Bisque and OME (Open Microscopy Environment). However, these systems do not fully meet the needs of experimenters with new metadata models or with metadata models that change continuously, as they often require changes to the underlying system. Flexible data management allows groups to easily incorporate the Bisque system into the new labs and groups with different experimental practices.

Flexible schemas will allow new datasets to be added or modified easily, but managing the inherent complexity in any data model is a significant challenge. Our system will be extended with services to enhance data sharing through ontology building, refinement, and search. The ontology builder will be tightly integrated into the system and allow users to organize and extend the ontology with domain knowledge. Users will be requested but not required to build their data models within the ontology framework. The search and browse functions will be extended to utilize the ontology system. We see the ontology system as key component for sharing data, domain knowledge and analysis results between groups of researchers.

We have extended Bisque such that all data resources (images, metadata, analyses) become accessible through simple XML interfaces and be available for aggregation, cross-correlation and searching. This permits web-based applications to be created based on the system. Our current prototype system acts as a portal for several other Bisque systems, allowing the perspective of a larger database formed from several instances of our current system. The ontology system described previously can be used to make data from diverse source accessible to other groups. As different groups develop their own data models, integration can become extremely difficult. The ontology support eases the integration of diverse data models.

Recent research at the center includes advances in image analysis and novel database techniques for dealing with uncertainty. We have developed and integrated new methods for image registration, segmentation, object identification, managing probabilistic and spatial information for bioimages. Bisque provides a platform for wide scale incorporation and validation of new methods as they become available.