Computationally-Intensive Tasks in Medical Imaging Informatics

Medical imaging informatics addresses initiatives to improve the performance of clinical radiology. These efforts range from managing images for reading by radiologists to computer-aided diagnosis. Many projects require significant image processing to extract image features for use in diagnosis or as reference queries for retrieving other images with similar characteristics. Effectiveness of such projects often depends on having large image data sets. Given the computational complexity of many image processing techniques and the number and size of medical images, medical imaging informatics tools are limited by hardware resources. Many tasks can be parallelized or adapted to distributed processing as available on grid-based technology, such as image processing feature extraction, dataset storage, content-based image retrieval (CBIR), and computer-aided diagnosis (CAD).

We propose using grid technologies for three specific medical imaging tasks: 1) automatic segmentation of liver tissue in computed tomography (CT) of the abdomen, 2) CBIR for retrieving lung nodule cases in CT, and 3) classification of tumors in mammography images. Each task has a significant requirement for image processing to extract low-level features; the feature independence, as well as the presentation of data as a grid of pixels allows for excellent opportunities to use grid technology. The high level algorithms built on extracted image features (segmentation, similarity measures, and machine learning, respectively) can be run in parallel in a number of different ways - image slices, number of retrieved images, and independent machine learning steps. Focus on grid-enabled techniques will permit inclusion of computationally complex algorithms and larger datasets than otherwise acceptable for the near-realtime performance requirement of clinically useable medical imaging applications.