Development of an expert system for quantification of brain activation in functional MRI

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Purpose: The purpose of this study is to develope an expert system for quantification of brain activation (Expert-QUBA) to automatically provide information on the brain centers and regional brain activity(%) and hemispheric lateralization index from the brain activation map.

Theory and Methodology: The 3-D fMR images were processed by SPM99 and MRIcro programs. These images were converted into the 2-D sectional images, followed by overlapping with T1-weighted images, where the image dataset was extended to -59mm to 83mm with 2mm slice-gab, giving 73 axial images. By using a pixel-to-pixel differentiation method, the difference of R, G, B values between T1-weighted images and activation images was calculated to give black & white (B/W) differentiation image in which each pixel is represented with 24-bit true R, G, B colors. Subsequently, B/W images were compared with two template images, functional and anatomical index images, to give functional and anatomical differentiation images that contain regional brain activation information based on Brodmann's and anatomical areas, respectively. In addition, the regional brain lateralization indices were automatically determined to give hemispheric predominance.

Conclusion: Expert-QUBA program is capable of providing accurate identification and quantification, of the brain activation and lateralization index with respect to functional and anatomical areas, respectively. Also, the processing time was 240 times faster as comparison with the manual counting method: ~10 hours for manual accounting and ~2.5 minutes for the Expert-QUBA program under a Pentium IV processor.