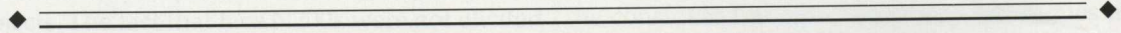


Functional Volumes Modeling: Theory and Preliminary Assessment

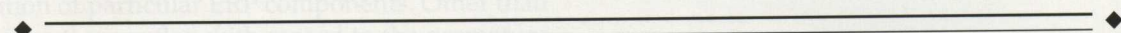
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Abstract: A construct for metanalytic modeling of the functional organization of the human brain, termed functional volumes modeling (FVM), is presented and preliminarily tested. FVM uses the published literature to model brain functional areas as spatial probability distributions. The FVM statistical model estimates population variance (i.e., among individuals) from the variance observed among group-mean studies, these being the most prevalent type of study in the functional imaging literature. The FVM modeling strategy is tested by: (1) constructing an FVM of the mouth region of primary motor cortex using published, group-mean, functional imaging reports as input, and (2) comparing the confidence bounds predicted by that FVM with those observed in 10 normal subjects performing overt-speech tasks. The FVM model correctly predicted the mean location and spatial distribution of per-subject functional responses. FVM has a wide range of applications, including hypothesis testing for statistical parametric images. *Hum. Brain Mapping* 5:306–311, 1997. © 1997 Wiley-Liss, Inc.

Key words: FVM; functional brain model; statistical model; Talairach; spatial hypothesis testing



INTRODUCTION

Mapping the functional organization of the human brain is a highly productive, rapidly growing field. Functional imaging studies are localizing the neural populations performing specific mental operations in the domains of perception, action, cognition, and emotion. A considerable portion of the functional-imaging literature has been reported as response coordinates (loci^{x-y-z}) referenced to the Talairach Atlas [Talairach and Tournoux, 1988]. Standardized anatomical referencing makes this literature uniquely well-

suited for metaanalysis. On the other hand, the majority of studies reporting on Talairach space do so for the purpose of creating group-mean, statistical parametric images (SPI[n]), pooling n subjects within the standardized space. Intersubject averaging typically precludes quantifying intersubject variability in functional anatomy. Functional volumes modeling (FVM) addresses the latter shortcoming through exploiting the former strength. Specifically, FVM estimates individual (per-subject) variability in the brain locations of specific mental operations through an analysis of variability among group-mean studies in the reported literature, and allows modeling of groups of various sizes based on this estimate.

THEORY AND STATISTICAL MODEL

FVMs model brain functional areas as bounded volumes. The bounds of an FVM express confidence

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