

Quantitative and Clinical Analysis of SPECT Image Registration for Epilepsy Studies

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This study reports quantitative measurements of the accuracy of two popular voxel-based registration algorithms—Woodard automated image registration algorithm and mutual information correlation—and compares these with conventional surface matching (SM) registration. **Methods:** The registration algorithms were compared (15 different matches each) for (a) three-dimensional brain phantom images, (b) an ideal SPECT image from a patient with partial epilepsy matched to itself after modification to simulate changes in the cerebral blood flow pattern and (c) icterohemictal SPECT images from 15 patients with partial epilepsy. Blinded visual ranking and localization of the subtraction images derived from the patient images were also performed. **Results:** Both voxel-based registration methods were more accurate than SM registration ($P < 0.0005$). Automated image registration algorithm was more accurate than mutual information correlation for the computer-simulated icterohemictal images and the patient icterohemictal studies ($P < 0.05$). The subtraction SPECTs from SM were poorer in visual ranking more often than the voxel-based methods ($P < 0.05$). **Conclusions:** Voxel intensity-based registration algorithms provide significant improvement in icterohemictal SPECT registration accuracy and result in a clinically detectable improvement in the subtraction SPECT images.

Key Words: Image registration; icterohemictal SPECT; partial epilepsy; cerebral blood flow

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Several computer-aided methods for producing subtraction ictal SPECT images coregistered to MRI (SISCOM) have recently been described as tools for improving the localization of the epileptogenic zone in focal epilepsy (1–4). These methods have been shown to significantly improve sensitivity and specificity compared with conventional visual analysis of icterohemictal SPECT images (3,5,6). The SISCOM methods involve acquiring both ictal and interictal SPECT images of regional cerebral blood flow (rCBF) using a radiolabeled tracer, usually ^{99m}Tc hexamethylpropylene amine oxime or ^{99m}Tc -ethyl cystinate dithylosate (ECD). These functional rCBF maps are then normal-

ized to mean cerebral pixel intensity to account for differences in total activity and isotope decay, registered using an accurate and robust matching algorithm to account for differences in patient position and slice level and subtracted to produce a functional map of the changes in rCBF during ictus compared with the resting state. This subtraction image is then thresholded to isolate significant blood flow changes and is registered to the patient's MRI image.

One of the major influences on the sensitivity and specificity of the SPECT subtraction image is the accuracy of the icterohemictal SPECT image alignment (7). Poor registration results in subtraction of nonanatomically corresponding voxels. This decreases the sensitivity of the final image by increasing the signal-to-noise ratio and may decrease specificity by producing false-positive activation sites. Brain surface matching techniques (7,8) have traditionally been used to produce subtraction SPECT images (1,2). Surface matching (SM) registration consistently matches SPECT images with better than 1 voxel dimension of accuracy (9); however, the literature suggests that even small misalignments may decrease the sensitivity of focal uptake detection (9). Hence, methods that provide more accurate interictal-to-ictal SPECT registration have the potential to further improve the sensitivity and specificity of epileptogenic localization.

The SM algorithm we originally used in SISCOM was developed by Jiang et al. (8) in 1992 and is available as part of the AnalyzeAVW software package (Mayo Foundation, Rochester, MN) (10). This algorithm has been extensively used by many centers and has been demonstrated to be robust and accurate for several different imaging modalities (11–13). Recently, several voxel-based registration algorithms have been proposed for inter- and intramodality image alignment, and these methods have been shown to be even more accurate than SM methods for a variety of applications (14). However, the performance of different algorithms depends greatly on the image modalities used and the registration task to be performed, and few have been compared quantitatively for matching functional rCBF images. In particular, the extensive changes in image contrast that accompany ictal activation could confound voxel-based registration algorithms. Most intramodality voxel-based algorithms depend on a certain consistency of voxel gray

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effects of benzodiazepines on the electrical activity of the central nervous system and diazepam metabolism in healthy subjects and patients with heart failure renal failure and hepatic cirrhosis The selection is a dependable reference for readers interested in neuropsychopharmacology **Neurometric Assessment of Brain Dysfunction in Neurological Patients**

Thalía Harmony,2021-07-18 Originally published in 1984 the aim of this book was to interest clinical neuroscientists in the application of neurometrics to the evaluation of brain dysfunction in neurological patients This methodology was hoped to produce substantial improvement in the neurological medical care of the general population at the time In the previous 15 years as a result of the development of minicomputers and their application to the quantitative analysis of electrophysiological phenomena there had been a great expansion of knowledge about the electrical activity of the brain This activity yielded a great variety of information about brain functions Neurometrics is a methodology based on quantitative measurements of the brain electrical activity for evaluating anatomical integrity developmental maturation and the mediation of sensory perceptual and cognitive processes This book focuses on practical clinical applications and the theoretical and experimental formulations on which these are based **Anticonvulsants** Julius Vida,2013-07-19 Medicinal Chemistry A Series of Monographs Volume 15 Anticonvulsants discusses the laboratory evaluation drug disposition clinical evaluation and synthesis and design of anticonvulsant drugs This book is organized into eight chapters Chapters 1 and 2 provide an overview and neuropharmacological background of anticonvulsants The laboratory evaluation of compounds is described in Chapter 3 while drug disposition is treated in Chapter 4 The chemistry and biological activities of the various classes of anticonvulsant compounds such as cyclic ureides benzopyrans heterocyclic drugs and noncyclic anticonvulsants are presented in Chapters 5 to 8 This volume is written specifically for medicinal chemists biochemists neurologists and pharmacologists **Current Catalog** National Library of Medicine (U.S.), First multi year cumulation covers six years 1965

70 **Medical Image Computing and Computer Assisted Intervention - MICCAI 2021** Marleen de Bruijne,Philippe C. Cattin,Stéphane Cotin,Nicolas Padoy,Stefanie Speidel,Yefeng Zheng,Caroline Essert,2021-09-23 The eight volume set LNCS 12901 12902 12903 12904 12905 12906 12907 and 12908 constitutes the refereed proceedings of the 24th International Conference on Medical Image Computing and Computer Assisted Intervention MICCAI 2021 held in Strasbourg France in September October 2021 The 531 revised full papers presented were carefully reviewed and selected from 1630 submissions in a double blind review process The papers are organized in the following topical sections Part I image segmentation Part II machine learning self supervised learning machine learning semi supervised learning and machine learning weakly supervised learning Part III machine learning advances in machine learning theory machine learning attention models machine learning domain adaptation machine learning federated learning machine learning interpretability explainability and machine learning uncertainty Part IV image registration image guided interventions and surgery surgical data science surgical planning and simulation surgical skill and work flow analysis and surgical visualization and mixed augmented and

virtual reality Part V computer aided diagnosis integration of imaging with non imaging biomarkers and outcome disease prediction Part VI image reconstruction clinical applications cardiac and clinical applications vascular Part VII clinical applications abdomen clinical applications breast clinical applications dermatology clinical applications fetal imaging clinical applications lung clinical applications neuroimaging brain development clinical applications neuroimaging DWI and tractography clinical applications neuroimaging functional brain networks clinical applications neuroimaging others and clinical applications oncology Part VIII clinical applications ophthalmology computational integrative pathology modalities microscopy modalities histopathology and modalities ultrasound The conference was held virtually

Behavioral Medicine with the Developmentally Disabled J.H. Kedesdy,D.C. Russo,2013-11-11 Since the late 1960s the behavioral treatment of mentally retarded autistic and other developmentally disabled persons has grown progressively more sophisticated The literature on behavioral treatment has produced effective and clinically significant programs for the reduction of maladaptive behaviors such as tantrums aggression and self injury skills deficits have been remediated through improved programs for language and life skills acquisition and new environments have been opened in the creation of mainstream educational opportunities In spite of these advances it strikes us that this almost exclusive focus on behavior problems and skills remediation has been somewhat myopic and that much of the potential for application of behavioral science to solving problems of the developmentally disabled is as yet untapped In the 1980s an important revolution has taken place the development of the field of behavioral medicine This field in merging disease treatment and management with learning and behavior has already made impressive progress toward a reconceptualization of health care that acknowledges the centrality of behavior in disease expression Although there has as yet been only a preliminary application of this reconceptualization to the field of developmental disabilities we are convinced that further extension has great potential

Mechanisms of Epileptogenesis Marc Dichter,2014-11-14 *Critical Reviews in Bioengineering* ,1981 *Advances in Clinical Chemistry* Gregory S. Makowski,2021-05-24 *Advances in Clinical Chemistry* Volume 102 the latest installment in this internationally acclaimed series contains chapters authored by world renowned clinical laboratory scientists physicians and research scientists The serial discusses the most up to date technologies related to the field of clinical chemistry Chapters in this new release cover Advances in immunosensor technology Extracellular Vesicles Roles and Applications in Drug Induced Liver Injury Oxidative stress biomarkers in the preterm infant Translational biomarkers in the era of precision medicine Metabolomics applications in coronary artery disease personalized medicine Quantitative EEG biomarkers for epilepsy and their relation to chemical biomarkers Provides the most up to date technologies in clinical chemistry and clinical laboratory science Authored by world renowned clinical laboratory scientists physicians and research scientists Presents the international benchmark for novel analytical approaches in the clinical laboratory

Advances in Stereotactic and Functional Neurosurgery 6 J. Gybels,E.R. Hitchcock,C. Ostertag,G.F. Rossi,J. Siegfried,G. Szikla,2012-12-06 Local interstitial

radiation therapy of intrinsic and inaccessible brain tumors is confronted with two major problems 1 The tolerance of normal brain tissue which is usually involved in local tumor irradiation i e perifocal white matter edema and demyelinating effects is crucial 2 Data on radiation effects of implanted radioactive sources on neoplastic tissue i e data on the radiosensitivity and on the biology of tumors are still widely unavailable In clinical practice the dose with which to achieve a given volume of tumor necrosis is roughly estimated This report deals with the experimental findings of Iodine 125 and Iridium 192 permanent implants in healthy and neoplastic brain tissue Our own experimental findings are correlated with experimental data on Yttrium 90 irradiation from the literature The study is directed to collect data on the tolerance non tumoral brain tissue and to attempt to establish a dose response relationship Morphologic Changes in the Dog Brain Following Interstitial Iodine 125 Irradiation Iodine 125 seeds manufactured by 3 M Company St Paul MN with an activity of 3 55 mCi were permanently implanted under stereotactic conditions into the subcortical white matter of the gyrus coronalis of the left hemisphere in 6 beagle dogs One animal with a non radioactive seed implanted under similar operative conditions served as a control The animals were allowed to survive 25 46 71 94 248 368 days respectively after the implantation The control animal survived 46 days A detailed description of the experimental procedure is given elsewhere 16 17

Statistical Methods for Modeling Human Dynamics Sy-Miin Chow, Emilio Ferrer, Fushing Hsieh, 2011-02-25 This interdisciplinary volume features contributions from researchers in the fields of psychology neuroscience statistics computer science and physics State of the art techniques and applications used to analyze data obtained from studies in cognition emotion and electrophysiology are reviewed along with techniques for modeling in real time and for examining lifespan cognitive changes for conceptualizing change using item response nonparametric and hierarchical models and control theory inspired techniques for deriving diagnoses in medical and psychotherapeutic settings The syntax for running the analyses presented in the book is provided on the Psychology Press site Most of the programs are written in R while others are for Matlab SAS Win BUGS and DyFA Readers will appreciate a review of the latest methodological techniques developed in the last few years Highlights include an examination of Statistical and mathematical modeling techniques for the analysis of brain imaging such as EEGs fMRIs and other neuroscience data Dynamic modeling techniques for intensive repeated measurement data Panel modeling techniques for fewer time points data State space modeling techniques for psychological data Techniques used to analyze reaction time data Each chapter features an introductory overview of the techniques needed to understand the chapter a summary and numerous examples Each self contained chapter can be read on its own and in any order Divided into three major sections the book examines techniques for examining within person derivations in change patterns intra individual change and inter individual differences in change and interpersonal dynamics Intended for advanced students and researchers this book will appeal to those interested in applying state of the art dynamic modeling techniques to the the study of neurological developmental cognitive and social personality psychology as well as neuroscience computer science

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