
Imaging Biomarkers

Luis Martí-Bonmatí
Angel Alberich-Bayarri
Editors

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Development and Clinical
Integration

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Luis Martí-Bonmatí
La Fe University
and Polytechnic Hospital
University of Valencia
Valencia
Spain

Angel Alberich-Bayarri
La Fe University
and Polytechnic Hospital
University of Valencia
Valencia
Spain

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Preface

This book started so many years ago. On those times, most researchers on medical imaging were involved in how to obtain the best images to achieve accurate diagnosis in clinical medicine. Detecting lesions and knowing the nature of what was found and how these findings impact treatment were the hallmarks of radiology for years. Our contribution was to initiate quantitative approaches to improve the way radiology was performed. In some way, measurements were not usual in the radiology departments, and, even, they were considered an inappropriate way to describe lesions when compared with the art of reporting images.

In this book on imaging biomarkers, we tried to describe how quantitative imaging changes the way we should interact with other physicians and patients from the first idea to the final clinical application. Imaging biomarkers might generate spatially and time-resolved *in vivo* maps of the distribution of some relevant disease hallmarks in individual patients.

The different chapters will deal with the shift in paradigm from descriptive signs and radiological findings toward a precision medicine where imaging plays a major role in the detection, grading, and localization of tissue abnormalities. The different international initiatives for the promotion of imaging biomarkers will be presented, together with the definition of their stepwise pipeline development. All the different parts to be considered when dealing with biomarkers will be precisely defined, starting from the biological basis and clinical question to be answered through the acquisition modalities and protocols definition, image preparation, and analysis. Those aspects related to how and where the measurements should be obtained, their main biases and sources of uncertainty, the reproducibility of the results and their validation, and the appropriate reporting to efficiently communicate the results are key aspects of this monograph. Ultimately, main clinical indications, pitfalls, and big data aspects of imaging biomarkers will be also presented. Some examples of imaging biomarkers in neurodegenerative diseases, brain and breast tumors, lung and cardiac diseases, and musculoskeletal and diffuse liver disorders will highlight their clinical relevance.

We hope that this text will be helpful for readers with very different backgrounds, who need to quantify and analyze imaging data to critically answer interesting clinical questions. Although this book is not intended to be a manual, it concentrates ideas and concepts relevant to most radiologists and biomedical engineers looking for fundamental concepts in radiomics and virtual biopsies. It is our understanding that *in silico* computational models obtained

from medical images and patient-specific processing have a great promise and expectation toward more effective and enduring disease ontology, signatures, and therapies.

We are indebted to many people who allowed this book to come into existence, mainly the authors and researchers whom we interacted with all over these years, and of course our families, who allowed us to spend time and energy in this beautiful and precise project.

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Luis Martí-Bonmatí
Angel Alberich-Bayarri

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