1. **Record Nr.** UNINA9910136807503321

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   Titolo Towards an Integrated Approach to Measurement, Analysis and Modeling of Cortical Networks

   Pubbl/distr/stampa Frontiers Media SA, 2016

   Descrizione fisica 1 online resource (264 p.)

   Collana Frontiers Research Topics

   Soggetti Neurosciences

   Lingua di pubblicazione Inglese

   Formato Materiale a stampa

   Livello bibliografico Monografia

   Sommario/riassunto The amount of data being produced by neuroscientists is increasing rapidly, driven by advances in neuroimaging and recording techniques spanning multiple scales of resolution. The availability of such data poses significant challenges for their processing and interpretation. To gain a deeper understanding of the surrounding issues, the Editors of this e-Book reached out to an interdisciplinary community, and formed the Cortical Networks Working Group. The genesis of this e-Book thus began with this Working Group through support from the National Institute for Mathematical and Biological Synthesis in the USA. The Group consisted of scientists from neuroscience, physics, psychology and computer science, and meetings were held in person (a detailed list of the group members is presented in the Editorial that follows). At the time we started, in 2010, the term "big data" was hardly in existence, though the volume of data we were handling would certainly have qualified. Furthermore, there was significant interest in harnessing the power of supercomputers to perform large scale neuronal simulations, and in creating specialized hardware to mimic neural function. We realized that the various disciplines represented in our Group could and should work together to accelerate progress in Neuroscience. We searched for common threads that could define the foundation for an integrated approach to solve important problems in the field. We adopted a network-centric perspective to address these challenges, as the data are derived from structures that are themselves network-like.

We proposed three inter-twined threads, consisting of measurement of neural activity, analysis of network structures deduced from this activity, and modeling of network function, leading to theoretical insights. This approach formed the foundation of our initial call for papers. When we issued the call for papers, we were not sure how many papers would fall into each of these threads. We were pleased that we found significant interest in each thread, and the number of submissions exceeded our expectations. This is an indication that the field of neuroscience is ripe for the type of integration and interchange that we had anticipated. We first published a special topics issue after we received a sufficient number of submissions. This is now being converted to an e-book to strengthen the coherence of its contributions. One of the strong themes emerging in this e-book is that network-based measures capture better the dynamics of brain processes, and provide features with greater discriminative power than point-based measures. Another theme is the importance of network oscillations and synchrony. Current research is shedding light on the principles that govern the establishment and maintenance of network oscillation states. These principles could explain why there is impaired synchronization between different brain areas in schizophrenics and Parkinson's patients. Such research could ultimately provide the foundation for an understanding of other psychiatric and neurodegenerative conditions. The chapters in this book cover these three main threads related to cortical networks. Some authors have combined two or more threads within a single chapter. We expect the availability of related work appearing in a single e-book to help our readers see the connection between different research efforts, and spur further insights and research.