

Chapter 7

Conclusive Remarks



Many natural and man-made systems are complex as they are formed by units that are dynamical and interact with each other. Such systems are modeled by a set of ordinary differential equations, often written in a dimensionless form to capture the generality of the approach, where a complex network accounts for the interactions among the system units. Despite each unit has its own intrinsic dynamics, which can differ from that of the other system elements, the presence of the interactions may generate the onset of a collective synchronous status, where all the units agree to follow a common behavior.

The regime where all the units follow the same behavior is not the only one possible in complex networks and different forms of synchronization have been discovered and characterized under the framework of coupled dynamical systems, unveiling a more rich, and in some cases more close to the real world, scenario. To make an example, the complete synchronization of all the neurons in the brain is associated to pathological epileptic states, whereas in normal conditions, neurons separate into groups showing different synchronous activities.

In this book, we have discussed key ideas, examples, and control techniques on synchronization in complex networks of nonlinear dynamical systems. Starting from global synchronization, we have examined chimera states, cluster synchronization, relay and remote synchronization and then also considered the case of time-varying links. All these topics are the subject of an intense research that day by day shapes our understanding of them. Often the phenomena observed have been named with different terms with some degree of overlap between the definitions given and studied independently each other without exploring the common aspects of the phenomenon, so that a study of the similarities and the differences between them is still to be fully addressed. With this book, we hope to have provided a short introduction to the theme that could give to the reader the basic concepts and tools and further stimulate the interest toward the research in the field.