Consensus on Electrical Networks

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Abstract

Even though the basic structure of Power Systems has remain the same along the years, it is widely accepted that the challeges they currently impose from the control perspective are very complex. Indeed, the penetration of renewable energy sources, the new deregulated market conditions, the existence of a (still) increasing number of nonlinear loads, the impossibility for implementing new transmission lines, among other, makes the task of delivering electrical energy a very complex enterprise. Under these conditions, it becomes necessary to re-approach the study of this highly nonlinear system with the aim to better understand the new phenomena exhibited during its operation. Moreover, it is the authors belief that going back to the basic concepts related with its structure could lead to re-discover elements that facilitate its analysis and controller design. In this talk, some preliminary and promising (in the authors opinion) results are presented for the analysis of electrical circuits that, using energy-based concepts and a graph theory framework, put in evidence some estructural properties under which is possible to achieve some consensus behaviors, i.e. it is shown what would be the structure of an electrical circuit to guarantee, for example, that a set of particular elements achieve the same voltage value. These results could be applied to find conditions to locate reactive power compensators or to implement load shedding protocols, for example.