Collective behavior of moving oscillators in three dimensional space

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Recently, collective behavior of time-varying complex network has been an active research area due to its potential application in power transmission system [1], consensus problem [2], mobile communication [3] etc. In time-varying network, the topology of the network changes over time due to random movement of the nodes or agents. The emerging behavior of such time-varying complex networks is synchronization. This time-varying network arises in functional brain networks [4] where the outcomes confirmed that the brain connectivity patterns develop with time and frequency while preserving a small-world structure. Also in

power transmission system [1] where a random reconnection of links between nodes has been taken into account, in consensus problem [2] in which robustness to changes in multi-agent network topology due to node or link failures is analyzed and this structure has also been investigated in mobile communication [3]. We propose the scheme of mobility in a more general way in a finite (cubical) region of three dimensional space and study networks of limit cycle as well as chaotic oscillators moving in that space. We discuss two fundamental emerging behaviors in complex network, namely, synchronization and amplitude death. Two types of interaction we consider, namely, coupling through similar variables and dissimilar variables [5]. In first type of coupling through similar variable, we model the synchronization process of a class of moving oscillators including chaotic systems which are moving in 3D space. Using second type of coupling through dissimilar coupling oscillation suppression state emerges in moving oscillators. The vision range of each oscillator decides the number of oscillators with which it interacts.

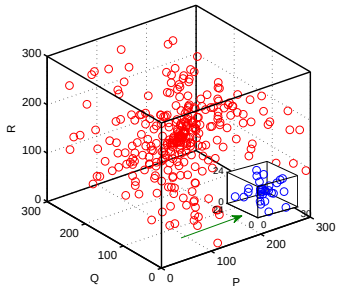

Figure 1: Moving oscillators (red circles) in three dimensional $P \times Q \times R$ node mesh. In particular, a cubical node mesh has been chosen with $P = Q = R = 300$. The oscillators (blue circles) lying in a subregion of rectangular parallelepiped structure is formed for a particular oscillator moving to its right, as indicated by the green arrow.

References

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