

Fizički odsjek Prirodoslovno matematičkog fakulteta Sveučilišta u Zagrebu
Bijenička c. 32, HR-10000 Zagreb

Zajednički seminar Fizičkog odsjeka i ZCI QuantiX

Vrijeme (s.t.)

Mjesto

utorak 15. 11. 2016., 14:15 h

predavaonica F201, II.kat

Color avoiding percolation

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In many complex systems representable as networks, nodes can be separated into different classes. Often these classes can be linked to a mutually shared vulnerability. Shared vulnerabilities may be due to a shared eavesdropper or correlated failures. In this paper, we show the impact of shared vulnerabilities on robust connectivity and how the heterogeneity of node classes can be exploited to maintain functionality by utilizing multiple paths. Percolation is the field of statistical physics that is generally used to analyze connectivity in complex networks, but in its existing forms, it cannot treat the heterogeneity of multiple vulnerable classes. To analyze the connectivity under these constraints, we describe each class as a color and develop a color-avoiding percolation. We present an analytic theory for random networks and a numerical algorithm for all networks, with which we can determine which nodes are color-avoiding connected and whether the maximal set percolates in the system. We find that the interaction of topology and color distribution implies a rich critical behavior, with critical values and critical exponents depending both on the topology and on the color distribution. Applying our physics-based theory to the Internet, we show how color-avoiding percolation can be used as the basis for new topologically aware secure communication protocols. Beyond applications to cybersecurity, our framework reveals a new layer of hidden structure in a wide range of natural and technological systems.

Voditelji seminara FO

Damir Pajić i Ivica Smolić