

# Convex Optimization of Cognitive Radio Networks

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Tutorial

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**Abstract:** It has been recognized that the radio spectrum is vastly underutilized, and an exciting paradigm has emerged that applies powerful aspects of optimization theory to the design and analysis of networks to efficiently utilize spectrum: Cognitive Radio Networks. Dynamic spectrum sensing via cognitive radio brings forth new intellectual and practical considerations. An optimization-theoretic approach has three distinctive characters. First, it unifies disparate problems and algorithms in wireless communication and networking and integrates various protocol layers. The approach thus enables cross-layering design from the physical layer to networking issues. Second, the watershed between efficiently solvable optimization problems and intractable ones has been recognized as convexity (instead of linearity as previously believed) thus opening up possibilities on nonlinear problems in cognitive radio network design. Third, some of the theoretical insights and tools are already being put into practice. These accomplishments have resulted in a keen interest from both academia and industry in systematically learning the new tools within the context of cognitive radio networks. This tutorial will provide a comprehensive treatment of recent results on convex optimization of cognitive radio networks.

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