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## 論文要旨

Covert relay communications, which aim to hide the existence of the wireless transmission process between legitimate users via a relay, have recently been regarded as an advanced secure communication paradigm to protect sensitive and confidential information for wireless communications. It is notable that the mode (i.e., transmission mode and forwarding mode) selection and relay selection techniques for covert relay communications play a crucial role in improving performance and efficiency. However, the joint transmission/forwarding mode selection and joint mode/relay selection for efficient covert relay communications in wireless systems remain unexplored issues. We first consider covert relay communication in a single-relay system, and develop theoretical models to show the system covert throughput performance under different combinations between transmission modes of full-duplex (FD)/half-duplex (HD) and forwarding modes of amplify-and-forward (AF)/decode-and-forward (DF). Based on these models, we propose a joint transmission/forwarding mode selection scheme to achieve the maximum covert throughput (MCT) in the system. We then consider covert relay communication in a multi-relay system with AF forwarding mode. For the scenarios when all relays operate in either fixed HD or FD transmission mode, we develop the corresponding relay selection schemes for covert relay communication in the system. For the scenario when all relays operate in the hybrid HD/FD mode where each relay can switch between HD and FD transmission modes, we propose a joint mode/relay selection scheme for covert relay communication in the system. Under either scheme, we develop related theoretical models for performance analysis, and also explore the optimal designs of transmit power, jamming power and target transmission rate for covert

throughput maximization. We further consider covert relay communication in a buffer-aided multi-relay system with DF forwarding mode, where each relay is equipped with an infinite buffer. For the scenarios when all relays operate in either fixed HD or FD transmission mode, we develop the corresponding relay selection schemes for covert relay communication in the system. For the scenario when all relays operate in the hybrid HD/FD mode, we propose a joint mode/relay selection scheme for covert relay communication in the system. We also develop related theoretical models for performance analysis under each scheme, and explore the optimal designs of transmit power, jamming power and target transmission rate for covert throughput maximization. Extensive numerical results are provided in this thesis to illustrate the impacts of joint transmission/forwarding mode selection and joint mode/relay selection on covert relay communications in different wireless relay systems. It is expected that the work in this dissertation can shed light on performance enhancement in future covert wireless communications.

#### 審査結果の要旨

This thesis explores the joint transmission/forwarding mode selection and joint mode/relay selection for efficient covert relay communications. The thesis first considers covert communication in a single-relay system, develops theoretical models for various combinations between transmission modes of full-duplex (FD)/half-duplex (HD) and forwarding modes of amplify-and-forward (AF)/decode-and-forward (DF), and proposes a joint mode selection scheme to maximize the covert throughput. The thesis then considers covert communication in a multi-relay system with AF forwarding mode and develops the corresponding joint transmission mode/relay selection scheme. Finally, the thesis explores the joint mode/relay selection scheme design in a buffer-aided multi-relay system with DF forwarding mode, where each relay is equipped with an infinite buffer.