

INFORMATION OF THE DOCTORAL THESIS

Thesis title: Research on physical layer security in massive MIMO systems with Rician fading channels.

Specialty: Telecommunications

Code: 9.52.02.08

PhD. Candidate: Vu Le Quynh Giang

Scientific supervisors:

1. **PhD. Truong Trung Kien**

2. **Assoc. Prof. Le Nhat Thang, PhD**

Training institution: Posts and Telecommunications Institute of Technology

NEW FINDINGS OF THE THESIS

Physical layer security of massive MIMO systems has been studied extensively due to its importance. Much prior work, however, assumed the simplest channel conditions of Rayleigh fading, which models non-line-of-sight (NLoS) propagation effects. This thesis considers the systems with Rician fading, which considers both NLoS and line-of-sight (LoS) propagation effects. In fact, Rayleigh fading is just a special case of Rician fading. The consideration of more realistic channel conditions is likely to give us more meaningful insights into the real-world systems at the cost of more challenges due to higher complexity. The key technical contributions of this thesis include:

1. Analytical results of the secrecy capacity of massive MIMO systems with Rician fading channel conditions and in the presence of passive eavesdropping devices.
2. Novel algorithms for detecting jamming devices, a.k.a., active eavesdropping devices, along with analytical results of their detection regions, detection probability, and false alarm probability under various scenarios of massive MIMO systems with Rician fading channel conditions.
3. Proposal of an enhanced solution to improve the probability of detecting interference caused by jamming devices in massive MIMO systems with Rician fading channel conditions based on temporal sub-band partitioning.

APPLICATIONS, PRACTICAL APPLICABILITY AND SUGGESTIONS FOR FUTURE WORK

The thesis has made scientific contributions to the research on the detection scheme of passive eavesdropping devices and jamming devices based on randomly transmitting N-PSK modulated signals.

The detection scheme only requires two training slots for detection at the base station without prior knowledge of the instantaneous channels. The study has shown that passive eavesdropping devices impact very little to the secrecy capacity of MIMO systems with Rayleigh fading channel conditions but significantly affect the secrecy capacity of MIMO systems with Rician fading channel conditions.

The research has provided insights into accurate detection probabilities. Numerical results indicate that the proposed detection scheme offers high detection probability and lower false alarm probability, nearly negligible. Building on the thesis's results and related studies, potential future work includes:

- 1) Investigation of the simultaneous impact of multiple active jamming devices in massive MIMO systems with spatially correlated Rician fading channels.
- 2) Study of the influence of spatial correlation in massive MIMO systems when multiple eavesdropping devices are present.
- 3) Exploration of the effect of spatial correlation in massive MIMO systems in the presence of multiple jamming devices.
- 4) Development of new methods for detecting unauthorized devices in massive MIMO systems with spatially correlated multi-user channels.

Confirmation of representative Scientific supervisor

PhD. Candidate

PhD. Truong Trung Kien Assoc. Prof. Le Nhat Thang

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