TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

disco distributed computer systems

When Neural-Networks meet Secure Location Verification:

A deep analysis of movement patterns on secure location verification with mobility-differentiated time of arrival

Location information is of extreme importance for many applications, such as access control or environmental sensing. The messages that convey this information are called location claims and the entities responsible for checking the trustworthiness of the claims are called verifiers. Many protocols were suggested in the past years and, although some solutions make use of mobile verifiers [1-3], there is still room for improvement.

Mobility-differentiated time of arrival (MDToA) is a technique that makes use of signal propagation delay observations in order to acquire information about the difference of distances between transmitter and receiver in time. Considering the verifiers' positions, this technique checks if the claimed location could correspond to the measured inter-arrival time interval between location claims. Since it does not require synchronization and requires simple mathematical operations to perform the verification, MDToA is beneficial for sensor networks that usually have cost, computational and energy constraints. Thus, it has been used for passive sensor localization [4] and track verification [5].

Despite of the presented advantages of using MDToA for location verification, the equation system generated to formally prove the security of the system is non-linear and depend on many parameters. Empirically there are some movement patterns of the verifiers known to provide higher security. However, due to the algebraic complexity of the problem, it is hard to guarantee that this known patterns are the best possible to achieve. Thus, neural-networks might shed some light on understanding the influence of each parameter and provide better movement patterns aiming at higher security.

Learning Opportunities and Support

Due to the interdisciplinary and challenging nature of the topic, it helps to improve critical thinking and stimulates creativity. Resources for a better understanding about the topic will be provided and it is a great opportunity to get experience on the secure location verification field as well as complex Neural-Networks.

Requirements

It is a very challenging topic that requires a good understanding of mathematics, physics, computer science and engineering. It is innovative, strongly research oriented and has an immediate applicability on the real world. Previous knowledge about secure location verification techniques as well as MDToA are not required. Ability to work independently, solid experience with Neural-Networks and programming skills are expected.

Interested?

Please contact **Carolina Nogueira (nogueira@cs.uni-kl.de)**. Do not forget to send a brief introduction about yourself, your interests and relevant qualification.

About us

We are the distributed computer system (disco - https://disco.cs.uni-kl.de) research group, located at the 4th floor of building 36. Our research focus is on performance and security of distributed systems.

References

[1] *S. Čapkun, K. Rasmussen, M. Čagalj and M. Srivastava, "Secure Location Verification with Hidden and Mobile Base Stations," in IEEE Transactions on Mobile Computing, vol. 7, no. 4, pp. 470-483, April 2008.*

[2] *Richard Baker and Ivan Martinovic. 2016. Secure Location Verification with a Mobile Receiver. In Proceedings of the 2nd ACM Workshop on Cyber-Physical Systems Security and Privacy (CPS-SPC '16). ACM, New York, NY, USA, 35-46.*
DOI: https://doi.org/10.1145/2994487.2994497

[3] *Marco Rasori, Pericle Perazzo, and Gianluca Dini. 2017. A Low-Cost UAV-Based Secure Location Verification Method. In Proceedings of the 12th International Conference on Availability, Reliability and Security (ARES '17). ACM, New York, NY, USA, Article 30, 6 pages.*
DOI: https://doi.org/10.1145/3098954.3098961

[4] *J. Luo, H. V. Shukla, and J.-P. Hubaux, "Non-interactive location surveying for sensor networks with mobility-differentiated toa," in Proceedings of the 25th IEEE International Conference on Computer Communications (INFOCOM), Apr. 2006.*

[5] *M. Schäfer, V. Lenders, and J. B. Schmitt, "Secure track verification," in IEEE Symposium on Security and Privacy, May 2015.*