

Air Traffic Control (ATC) Resilient Response Model Amid Automatic Dependent Surveillance-Broadcast (ADS-B) Ghost Aircraft Spoofing Cyberattack

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Abstract

The openness and unencrypted nature of the Automatic Dependent Surveillance-Broadcast (ADS-B) system poses a constant significant threat of cyberattack in the form of false message injection to the air traffic surveillance system. Among the attack types within the category of false message injection which is easy to launch and potentially causing high negative impact to Air Traffic Management (ATM) is the Ghost Aircraft Spoofing (GAS) attack that can be easily launched via a software-defined radio device targeting a ground station. In more serious integrated attack scenarios, this attack type aims to create confusion to the Air Traffic Controller (ATC) by exploiting the already degraded air traffic surveillance capability. The immediate impact of this attack is delayed aircraft arrivals and departures in the context of flight operations. Moreover, prolonged attacks will cause greater impact, disrupting airport operations related to ground movement for taxiing-in and taxiing-out.

To mitigate this incident, this dissertation first, analyses the immediate impact to the arriving aircraft which are in descent phase, and later the cascading effects it brings to the departure operations and aircraft ground movement in quantitative terms of accumulation of delay time and number of affected aircraft. The methodology used for quantification is through statistical data from formation of First-In-First-Out (FIFO) queues representing pertinent queuing functions applied by the ATC in the entire Arrival-Ground Movement-Departure (AGMOD) dynamics. Next, this dissertation proposes two types of mitigation plan based on possible ATC responses to reduce the delay time for arriving and departing aircraft. The arriving aircraft is guided by a tactical framework which continuously explores the ideal deviational flight path that is shortest at that point of time and with less to no interference by other aircraft. The second proposed response plan focuses on the departure sequencing by countering uncertainties optimistically through synchronous aircraft movement for taxiing-out. The proposed approach comparatively records positive results with more aircraft at several designated taxiway zones close to the runway than the conventional approaches which permit departures based on either original schedule time prior the GAS attack or based on prioritization for aircraft closest to the runway to move ahead of others.

List of publications

Name: KAMARUZZAMAN MOHD RUZEINY

Peer review journal paper (Author[underline your own name], Thesis title, Journal title, Volume, Number, Pages, Date, The chapter or section of your dissertation which this paper relates)

1. Mohd Ruzeiny Kamaruzzaman, Md Delwar Hossain, Yuzo Taenaka, Youki Kadobayashi, "Mitigation of ADS-B Spoofing Attack Impact on Departure Sequencing through Modulated Synchronous Taxiing Approach", IEEE Open Journal of Intelligent Transportation Systems, pp. 1-1, June 2023.
- related to Chapter 5 in the dissertation.

Peer review journal paper (letters, technical reports etc. The format is the same as above.)

Peer review international conference (Author[underline your own name], Thesis title, Journal title (or conference name) , (Volume, Number, Pages), Date, The chapter or section of your dissertation which this paper relates)

1. Mohd Ruzeiny Bin Kamaruzzaman, Bernard Ousmane SANE, Doudou FALL, Yuzo Taenaka, Youki Kadobayashi, "Analyzing Cascading Effects of Spoofing Attacks on ADS-B Using Discrete Model of Air Traffic Control Responses and AGMOD Dynamics", in Proceedings of IEEE International Conference on Cyber Security and Resilience (IEEE CSR 2021), July 2021.
- related to Chapter 3 in the dissertation.
2. Mohd Ruzeiny Bin Kamaruzzaman, Doudou Fall, Md Delwar Hossain, Yuzo Taenaka, Youki Kadobayashi, "Modulated Synchronous Taxiing: Mitigating Uncertainties Amid ADS-B Spoofing", in Proceedings of the 2022 22nd Integrated Communication, Navigation and Surveillance Conference (ICNS), pp. 1-13. May 2022.
- related to Chapter 5 in the dissertation.
3. Mohd Ruzeiny Kamaruzzaman, Muhammad Delwar Hossain, Yuzo Taenaka, Youki Kadobayashi, "ATC Level Tactical Manoeuvring during Descent for Mitigating Impact of ADS-B Message Injection Cyber Attack", presented in The 10th OpenSky Symposium, Engineering Proceedings 28(1), 14, November 2022.
- related to Chapter 4 in the dissertation.

※If you can not fit everything on one page, include your most important work, and indicate the number of papers that you do not include.