

Thesis title : Enhancing the security of a communication system using fractional-order chaotic systems

Doctorant: Atoussi Mahdi Abdelghani

Directeur de thèse: Saadi Slami

Co-directeur: Nail Bachir

Université: Ziane Achour-Djelfa.

Faculté: Sciences et de la Technologie.

Laboratoire: Laboratoire d'Automatique Appliquée et Diagnostic Industriel (LAADI).

1- Résumé :

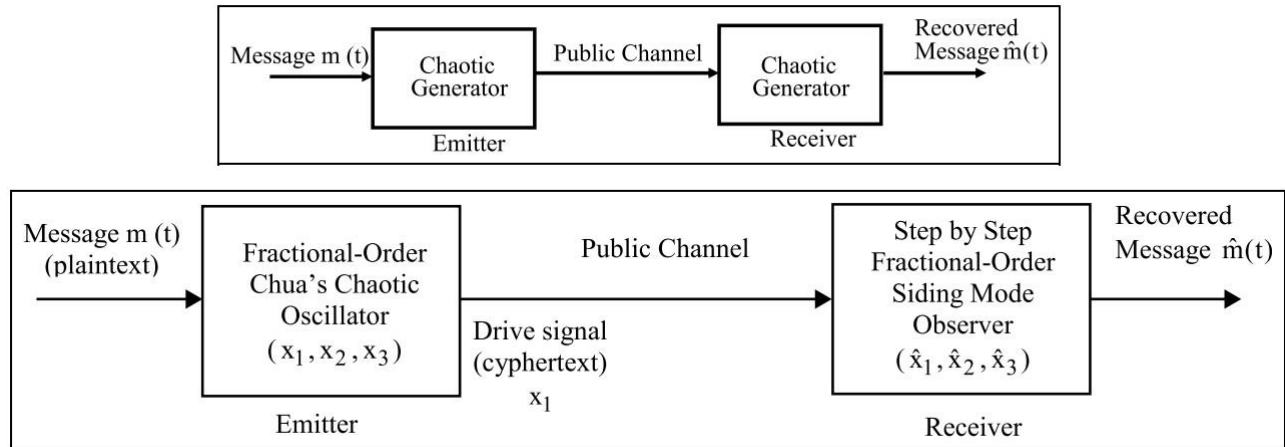
Chaotic systems are with highly nonlinear and complex dynamics. Furthermore, chaotic systems are extremely sensitive to initial conditions with the random-system-like behavior. Due to the high unpredictable and random-look nature of chaotic systems, chaos synchronization schemes have been applied for the secure communication systems (SCSs). This thesis includes the design of a fractional-order chaotic safe communication system. Recently, there are no way that allow identification of the order of derivative, and identifiability of fractional-order derivatives stays an open problem.

- On the emitter side, a fractional-order chaotic system is used as the drive system to create the encrypted message signal.
- The input secret message is modulated in the chaotic dynamics by insertion rather than being directly inserted to the chaotic signal on the transmission line.
- At the receiver side, a step-by-step fractional-order chaotic observer subject to unidentified input is suggested as the response system to get robust synchronization between the emitter and the receiver.
- After chaos synchronization is attained at the receiver side, an estimation of the state variables is obtained, and the original message is recovered.

2- Mots clés:

Fractional-order system, Synchronization, Secure communication, Data, Chaotic system, Observer, Observability, Controllability, Convergence, Controller, Stability, Delay, Robustness.

3- Graphical Abstract



4- Plan de la thèse :

- 1-State of art in the security of a communication systems: past and recent contributions
- 2-Simulation of fractional-order chaotic systems
- 3-Observers design of fractional-order chaotic systems for synchronization and at the same time to reconstruct the message considered as an unknown input.

5- Références Bibliographique:

Books:

- 1- Ivo Petras, Fractional-Order Nonlinear Systems Modeling, Analysis and Simulation
- 2- Kilbas and Srivastava and Trujillo, Theory and Applications of Fractional Differential Equations
- 3- Sabatier, Agrawal and Machado Advances in Fractional Calculus Theoretical Developments and Applications in Physics and Engineering

Papers:

- 4- The pioneering work of Pecora and Carroll "Synchronization in Chaotic Systems", 1990.
- 5- The pioneering work of Nijmeijer and Mareels, "An Observer Looks at Synchronization", 1997.
- 6- The pioneering work of Arman Kiani "A chaotic secure communication scheme using fractional chaotic systems based on an extended fractional Kalman filter", 2009
- 7- The pioneering work of Ruoxun Zhang "Synchronization of the fractional-order chaotic system via adaptive observer", 2014.
- 8- The pioneering work of Hamiche "Secure data transmission scheme based on fractional-order discrete chaotic system", 2015.
- 9- The pioneering work of Maamar Bettayeb "Single channel secure communication scheme based on synchronization of fractional-order chaotic Chua's systems ", 2017.