

Research Internship Proposal 2020-2021

Inria (l'institut national de recherche dédié aux sciences du numérique) is recruiting a research and development intern in computer science under the LIRIMA Agrinet project.

Topic: Image Processing based Data Reduction Technique in Wireless Video Sensor Networks for LiveStock farming Monitoring in Smart Agriculture

Tutors: Christian SALIM, Post-Doc Researcher
Nathalie MITTON, Research Director

Internship conditions

- **Duration:** 4 to 6 months starting February-March 2021
- **Deadline to Apply:** December 15, 2020
- **Location:** Inria, 40 Avenue Halley 59650 Villeneuve d'Ascq, France
- **Hosting Team:** FUN (Future Ubiquitous Networks)

Internship Description

Keywords: Wireless Video Sensor Networks, Smart Agriculture, Event Detection, Animals behaviour, Livestock farming, Video Surveillance, Machine Learning.

Context:

Nowadays, the agriculture domain faces a lot of challenges for a better usage of its natural resources. Wireless Sensor Networks (WSN) can serve as a monitoring system for meteorological data and soil conditions as mentioned and explained in [5]. However, the agriculture domain includes the livestock farming, thus, the animal behaviour is to be well monitored. To be able to monitor the animal behaviour and detect any anomaly in this behaviour, a Wireless Video Sensor Network (WVSN) can be deployed. WVSN represents a low-cost monitoring solution compared to other technologies such as CCTV.

WVSNs are composed of low-power resource-constrained video sensor nodes (motes), these nodes capture frames from videos with a given frequency (frame rate) and wirelessly send them to the sink.

However, many challenges exist in such networks [1], [4]. First, sensor nodes are devices with limited processing, memory and energy resources. Second, the collected data (frames), is by nature voluminous on the sensing, processing and transmission levels especially at the sensor node. Therefore, proposing data reduction algorithms to reduce the amount of data captured and transmitted from the sensor node to the coordinator is primordial as proposed in [1] and [3] using different techniques. The data reduction algorithm must preserve the information while reducing the amount of data. This reduction helps decrease the severity of several flaws such as the energy consumption and the bandwidth usage. Other challenges exist while using WVSN such as security, the communication protocol, the delays, etc.... In this internship a data reduction approach is proposed at the sensor node level, combining different aspects from the approaches in [1], [2], [3].

Objectives:

As already mentioned, frames collected by the motes are naturally voluminous and require a big amount of energy to be captured, processed and transmitted. Several techniques exist in the literature to reduce the amount of data aiming to reduce the energy consumption on the sensor node level and the bandwidth usage of the overall network [1], [2], [3], [4].

The aim of this research internship is to develop an approach that groups different aspects of data reduction at the sensor node level, inspired from the work done in [1], [2], [3] and [4] and other techniques in the literature. The proposed method should take into consideration the constraints faced in Wireless Sensor Networks. Then, simulations and experimental results will be conducted. This approach should be evaluated and improved based on the obtained results.

Candidate requirements:

The candidate should be a Master 2 student or a 5th year engineering student in Computer Science and has the following skills:

- Good programming skills in Python and Matlab
- Good knowledge in Machine Learning topics
- Preferably has some knowledge in wireless sensor networks
- Good Level in English
- Interested in pursuing an academic career (e.g PhD)

Any request of information as well as applications (CV + Cover Letter) should be sent to christian.salim@inria.fr, nathalie.mitton@inria.fr

References

- [1] Salim, C., Makhoul, A., Darazi, R. et al. Similarity based image selection with frame rate adaptation and local event detection in wireless video sensor networks. *Multimed Tools Appl* (2019) 78: 5941.
- [2] Rui Dai, Ian F. Akyildiz, "A spatial correlation model for visual information in wireless multimedia sensor networks", *IEEE TRANSACTIONS ON MULTIMEDIA*, vol. 11, no. 6, pp. 11481159, 2009.
- [3] Salim, C., Makhoul, A. & Couturier, R.. Energy-efficient secured data reduction technique using image difference function in wireless video sensor networks. *Multimed Tools Appl* (2019). <https://doi.org/10.1007/s11042-019-08333-2>.
- [4] Jiang B, Ravindran B, Cho H (2013) Probability-based prediction and sleep scheduling for energy-efficient target tracking in sensor networks. *IEEE Trans Mobile Comput* 12(4):735–747
- [5] Salim C., Mitton N. (2020) Machine Learning Based Data Reduction in WSN for Smart Agriculture. In: Barolli L., Amato F., Moscato F., Enokido T., Takizawa M. (eds) *Advanced Information Networking and Applications. AINA 2020. Advances in Intelligent Systems and Computing*, vol 1151. Springer, Cham. https://doi.org/10.1007/978-3-030-44041-1_12