



ESR Project title: Energy-efficient federated learning at the wireless network edge [ESR6]

Contact names: Deniz Gündüz (d.gunduz@imperial.ac.uk)

Institution: Imperial College London

Application deadline: May 31, 2021

ESR Project Description:

A huge amount of data is generated by IoT devices at the wireless network edge, such as smartphones and autonomous vehicles. Current machine learning (ML) approaches are mostly limited to centralized solutions, where all the data acquired by the edge devices is sent to a cloud server. However, offloading the edge data to cloud servers is often infeasible due to privacy and latency constraints; moreover, this would create significant network traffic and consume valuable bandwidth and energy resources, particularly for very large datasets (an autonomous vehicle generates about one gigabyte of data per second). Federated learning (FL) has recently emerged as an alternative distributed learning approach, to enable ML at the network edge with localized data. The objective of this project is to design energy-efficient FL algorithms taking into account practical limitations of the wireless links connecting the devices, such as fading, interference, link failures, and imperfect channel state information.

Expected Results:

(1) Design and development of novel federated learning methods for energy-limited IoT devices over band-limited wireless links; (2) A theoretical analysis of the convergence properties of the proposed distributed learning schemes; (3) Implementation and testing of the developed techniques on a practical wireless platform.

Supervision and Mobility Program:

Once hired, the candidate:

- will be employed at Imperial College London as a Research Assistant, performing full-time research under the supervision of Prof Deniz Gündüz.
- will also be enrolled in the PhD program at the same institution,
- will additionally pursue two secondments at Carnegie Mellon University and Toshiba Research Europe for durations of 6 and 4 months, respectively.

Required, Preferred and Desired Prerequisites/Skills:¹

- **Required:** At the time of recruitment, the applicant must not have lived in UK for more than 12 months in the previous 36 months (3 years).
- **Required:** No more than 4 years spent in research/work activities after the achievement of the MS degree.

¹ **Required**, means mandatory to pass the eligibility check. **Preferred**, means highly welcome and recommended. **Desired**, means additional, not strictly needed, but still very much appreciated.



- **Preferred:** A Master's degree in Telecommunications, Electrical Engineering, Computer Science, Data Science or equivalent.
- **Preferred:** Very good communication skills in oral and written English.
- **Preferred:** Open-mindedness, strong integration skills and team spirit.
- **Desired:** Good command of the Python programming language.
- **Desired:** Master's level training in machine learning techniques.
- **Desired:** Prior experience of successfully conducting research and publishing results in top scientific journals and/or conferences.

Additional requirements for this position

The candidate must satisfy all the PhD level entry requirements (country specific academic requirements, as well as English requirements) of Imperial College London as specified at: <https://www.imperial.ac.uk/study/pg/apply/requirements/>