2018-00888 - From finite blocklength information theory to multi-user M2M communication protocols

Type de contrat : CDI de la fonction publique
Niveau de diplôme exigé : Bac + 5 ou équivalent
Autre diplôme apprécié : Master en ingénierie de communication, informatique, science des données et mathématiques.
Fonction : Doctorant
Niveau d'expérience souhaité : Jeune diplômé

A propos du centre ou de la direction fonctionnelle

Grenoble Rhône-Alpes Research Center gather a few less a 800 people in 35 research teams and 9 research support departments.

Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas.

In the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

Contexte et atouts du poste

Within the framework of a partnership (you can choose between)
  - collaboration between Inria teams SOCRATE (Lyon), AGORA (Lyon), INFINE (Saclay) and EVA (Paris).
  - with Nokia Bell Labs through the joint laboratory between Inria and Nokia Bell Labs.

Mission confiée

Assignments :
Under the supervision of Prof. Jean-Marie Gorce (Insa Lyon / Inria) and Dr Philippe Jacquet (Nokia / Bell Labs), the recruited candidate will develop a cutting-edge research to model, analyze and design new low-layer collaborative protocols for M2M communications.

For a better knowledge of the proposed research subject :
Despite its 60 years of existence, information theory is still a very exciting research domain. The new era of machine to machine (M2M) communications brings to us a new paradigm characterized by three main features :
  - Information to be exchanged is made of numerous, rare, very small information quantities spread over the network.
  - Usual signaling techniques (headers, pilots, ...) play a critical role and may represent the main part of the data flows circulating in the network.
  - Ultra Reliable and Low Latency Communications (URLLC) required for haptic services, impose extremely reactive protocols, which require new PHY/MAC designs.

The objective of this PhD is to propose a comprehensive theoretical framework and to develop new collaborative coding techniques adapted to this new paradigm.

Collaboration :
The recruited person will work under the supervision of Prof. Jean-Marie Gorce in the team Socrate of Inria, located at CITI laboratory at INSA Lyon, in strong connection with the Nokia Bell Labs research centre, and in collaboration with other teams of Inria: AGORA, INFINE and EVA.

Informations générales

- Thème/Domaine : Réseaux et télécommunications
- Système d' réseaux (RAB E)
- Ville : Villeurbanne
- Centre Inria : CRI Grenoble - Rhône-Alpes
- Date de prise de fonction souhaitée : 2018-09-03
- Durée de contrat : 3 ans
- Date limite pour postuler : 2018-08-31

Contacts

- Equipe Inria : SOCRATE
- Recruteur : Gorce Jean Marie / jean-marie.gorce@inria.fr

A propos d’Inria

Inria, institut de recherche dédié au numérique, promeut « l’excellence scientifique au service du transfert technologique et de la société ». Inria emploie 2700 collaborateurs issus des meilleures universités mondiales, qui relèvent des défis des sciences informatiques et mathématiques. Son modèle ouvert et agile lui permet d’explorer des voies originales avec ses partenaires industriels et académiques. Inria répond ainsi efficacement aux enjeux pluridisciplinaires et applicatifs de la transition numérique. Inria est à l’origine de nombreuses innovations créatrices de valeur et d’emplois.

L’essentiel pour réussir

The candidate should have earned an MSc degree, or equivalent, in one of the following field: information theory, signal processing, electrical engineering, applied mathematics.

He/she should have a strong background in probabilities and information theory as well as in signal processing for wireless communications. He/she can easily manipulate algebra and mathematical analysis, convex or non convex optimization, measure and estimation theory.

He/she is willing to confront theory to experimental results and for such, the candidate is able to program and to conduct experimentation on software radio platforms.

Conditions pour postuler

Sécurité défense :
Ce poste est susceptible d’être affecté dans une zone à régime restrictif (ZRR), tel que défini dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L’autorisation d’accès à une zone est délivrée par le chef d’établissement, après avis ministériel favorable, tel que défini dans l’arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l’annulation du recrutement.

Politique de recrutement :
Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

Attention : Les candidatures doivent être adressées par d'autres canaux n'est pas garanti.
communication protocol stack to balance latency and reliability with side constraints such as energy efficiency or computational complexity.

The key elements for these communications are to reduce drastically the needs for synchronization, signalling and detection issues. The packet should be encoded such that all these steps can be performed jointly to avoid costly and long headers to be transmitted.

The proposed approach will rely on estimation theory and hypothesis testing techniques to design new optimal techniques to transmit very short packets (typically less than 100 bits) in a multi-user scenario. The key issue for such problem is to increase diversity at the receiver: multi-antennas reception, opportunistic relaying, joint transmission, multi-user detections are fundamental techniques that have to be reshaped in the context of small packets.

We will take care about the multi-objective framework: increasing reliability should not be done at a high price in terms of complexity or energy efficiency.

The candidate will leverage on recent results in information theory and on hypothesis testing to establish new performance bounds and to derive some fundamental trade-offs (e.g. energy-reliability, latency-reliability, energy-capacity,...), leading to the characterization of optimal multi-user transmission schemes in the Bayesian sense.

This framework will help to design new distributed coding techniques including opportunistic cooperation and relaying. The performance of the proposed algorithms will be confronted to the theory, validated by simulation and experimentally assessed on the platform FIT/Cortelab.

Some references relative to this topic:

Compétences

Technical skills and level required:
- theoretical background: probability and statistics, algebra, functional analysis, optimization theory, signal processing.
- specialization in one of these fields: estimation theory, measure theory, information theory, coding.
- programming: familiar with Matlab, Python or C/C++ languages.
- experience in GNU radio programming is not mandatory but would be appreciated.

Languages:
- English: read/write/speak fluently.
- French is optional.

Relational skills:
- Strong autonomy, innovation, ideas.
- Like to collaborate, to confront ideas.
- Open mind.

Avantages sociaux

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities

Rémunération

Gross income: 1982€ the 1st and 2nd year; 2085€ the 3rd year.