
Contract type: Public service fixed-term contract
Level of qualifications required: PhD or equivalent
Fonction: Post-Doctoral Research Visit

Context
The MiMove team at Inria Paris (https://mimove.inria.fr) undertakes research enabling next-generation mobile distributed systems and networks, from their conception and design to their runtime support, with focus on both middleware and data.

MiMove's research, in particular, accounts for the presence of large and volatile populations of mobile and resource-constrained devices, such as user handhelds and wireless sensors, as well as of fast evolving, global networking and computing infrastructures. We study systems that are dynamically composed from heterogeneous network resources in the near (pervasive) and remote (Internet, cloud) environment, and that furthermore adapt to their highly changing execution context, whether technical, physical or social. The latter two aspects are particularly manifested through the physical but also social sensing and actuation capabilities of mobile devices and their users. More specifically, leveraging the massive adoption of smartphones and other user-controlled mobile devices, besides physical sensing – where a device's sensor passively reports the sensed phenomena – social sensing and social crowd-sensing come into play, where the user is aware of and indeed aids in the sensing of the environment.

Mobile systems with the above specifics further push certain problems related to the Internet and user experience to their extreme: (i) Technology is too complex. Most Internet users are not tech-savvy and hence cannot fix performance problems and anomalous network behavior by themselves. The complexity of most Internet applications makes it hard even for networking experts to fully diagnose and fix problems. Users can't even know whether they are getting the Internet performance that they are paying their providers for. (ii) There is too much content. The proliferation of user-generated content (produced anywhere with mobile devices and immediately published in social media) along with the vast amount of information produced by traditional media (e.g., newspapers, television, radio) poses new challenges in achieving an effective, near real-time information awareness and personalization. For instance, users need novel filtering and recommendation tools for helping them to decide which articles to read or which movie to watch.

Assignment
The above challenging context raises key research questions:

- How to deal with heterogeneity and dynamicity, which create runtime uncertainty, when developing and running mobile systems in the open and constantly evolving Internet and IoT environment?
- How to enable automated diagnosis and optimization of networks and systems in the Internet and IoT environment for improving the QoE of their users?
- How to raise human centric crowd-sensing to a reliable means of sensing world phenomena?
- How to deal with combination, analysis and privacy aspects of Web/social media and IoT crowd-sensing data streams?

Main activities
In response to the research questions identified above, the postdoc researcher is expected to contribute to MiMove's research in one of the following topics:

- **Emergent mobile distributed systems.** We study techniques enabling emergence of mobile distributed systems in a beforehand unknown, ever-changing environment, while assuring that their required properties are met. These are systems that, due to their automated, dynamic, environment-dependent composition and execution, emerge in a possibly non-anticipated way and manifest emergent properties, i.e., both systems and their properties take their complete form only at runtime and may evolve afterwards.

- **Large-scale mobile sensing and actuation.** MiMove investigates algorithms and protocols for efficient coordination of future mobile sensing and actuation systems, with a special focus on the quality of sensing. We deal with challenges arising from the extremely large number of devices, their dense deployment, short sensing periods and time constraints in the sensing and actuation cycle.
scale, dynamicity and resource constraints of mobile devices, a great number of which will be attached to people, manifesting uncontrolled mobility behavior.

- **Mobile social crowd-sensing.** MiMove investigates the capabilities and challenges resulting from social sensing, which, by directly involving the users, enables sensing phenomena beyond the typical physical sensing (e.g., subjective crowdedness causing discomfort or joyfulness, as in a bus or in a concert) and can lead to a feeling of being more socially involved for the citizens. We study solutions to the combination of physically and socially sensed data, incentives for user participation and assurance of user data privacy, as well as novel mobile apps enabling empirical studies of the complex social behaviors involved.

- **Active and passive probing methods.** We are developing methods that actively introduce probes in the network to discover properties of the connected devices and network segments. We are focusing in particular on adaptive methods to discover properties of home networks and to distinguish if performance bottlenecks lie within the home network versus outside. We are also developing passive methods that simply observe network traffic to infer the performance of networked applications and the location of performance bottlenecks, as well as to extract patterns of web content consumption.

- **Inferring user online experience.** We are developing hybrid measurement methods that combine passive network measurement techniques to infer application performance with techniques from HCI to measure user perception. We will later use the resulting datasets to build models of user perception of network performance based only on data that we can obtain automatically from the user device or from user’s traffic observed in the network.

- **Big data stream mining and processing.** Advanced analysis of big data streams from sensors embedded in the environment and wearable or mobile user devices is becoming a key area of data mining research. However, the high data speed in conjunction with the low data quality of IoT data streams challenges traditional Machine-Learning (ML) approaches. We study the effect of the previous on ML algorithms and how to automate data pre-processing tasks (in particular cleaning).

**Skills**

The candidate should have a PhD in Computer Science with expertise – including experience in the implementation of related software prototypes – in one and possibly several of the following topics:

- Mobile distributed systems,
- Middleware architectures and protocols,
- Networks and network protocols,
- Network measurements,
- Software engineering,
- Wireless sensor networks,
- Data mining and analysis,
- Social networks.

**Benefits package**

- Subsidised catering service
- Partially-reimbursed public transport

**Remuneration**

- Location: Paris 12ème
- Gross Salary per month: 2 653€ brut/mensuel

Security and defense procedure:

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST).

Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.