Post-doctoral position

Protecting privacy in mobile apps using predictive control and machine learning techniques

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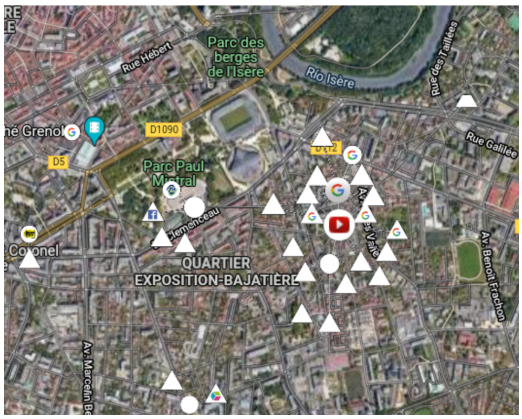
Institutions: This Post-Doctoral research is held in collaboration between the MIAI (Multidisciplinary Institute in Artificial Intelligence) Research Institute [1] and Université Grenoble Alpes, France

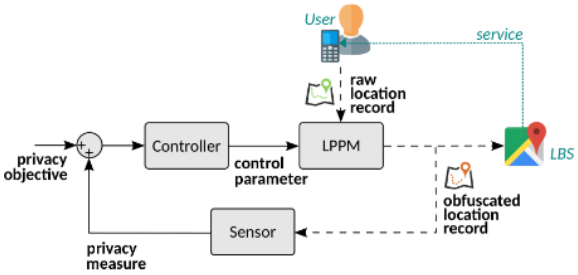
General context of the project: Privacy / Utility tradeoff in mobile tracking applications

Predominant in nowadays society, mobile apps are rising as application systems for control theory. Indeed, an app can be seen as a plant processing input signals and generating outputs. Ensuring that the app complies with a desired behavior, with guarantees, is a major safety challenge with impact on a very wide scope, as highlighted by the European Commission Strategic Plan [1] or the Location Privacy Protection Act [2] in the US.



Regulation of IT systems has emerged in the 2000's with the concept of Autonomic Computing [8], aiming at software self-adaptation. State-of-the-art works investigate the use of control theory for modeling and decision-making in computing systems, opening an entire promising field of research.

Scope of the research: Privacy in mobile apps



Location privacy protection considers mobile devices users whose mobility information is shared with untrusted parties. Applications and services tend to require location data to personalize users experiences. Examples of location-based services are navigation applications, recommendation systems, weather forecasting or fitness tracking apps [a].

[a] https://play.google.com/store/apps/category/TRAVEL_AND_LOCAL

Mobile apps provide those personalized and convenient services at the cost of personal data disclosure (one gains in service utility at the cost of sharing personal data). Service providers or third party attackers can take advantage of these data to derive private information about users.

Location Privacy Protection Mechanisms emerged as solutions to protect users privacy [12]. Such algorithms modify the location data to improve privacy, e.g. by adding noise [4], [6], reducing data precision [7], or merging close users locations [3].

[1] https://miai.univ-grenoble-alpes.fr/

In this research we focus on an online solution to improve performance, that is intelligently adding noise to the location data. The aim of the obfuscation methods is to hide the relevant information on the user position while preserving utility services quality by artificially perturbing the transmitted location.

Data is an important part of this project as the developed techniques will need to be validated on real location records. The team has access to four mobility datasets collected in a real environment: the Cabspotting[2], the PRIVAMOV[3], the GEOLIFE [14], and the Mobile Data Challenge datasets [9], amounting to a total of 770 users and more than 14 000 000 records.

Objectives of the post-doc: Optimization techniques, as well as optimal and predictive control methods [5, 13], can be used to infer and predict the optimal obfuscated location to be transmitted with the aim of maximizing the competing objectives of utility and privacy preservation. Machine learning tools [10, 11] can be used for the online implementation of low computational approximations of the optimal obfuscation strategies.

The obfuscation problem consists, in fact, in the online determination of the value of the position to be transmitted that maximizes the privacy among those that guarantee a minimal utility measure. Analogously, an optimization problem can be posed aiming at minimizing the utility loss among the possible transmissible positions ensuring a certain minimal privacy level.

Moreover, based on the available dataset, it is possible to compute offline the optimal obfuscated positions that minimize a cost concerning also the future values of utility loss and privacy performance. This would permit to take into account also the effect of the current choice in the future values of utility and privacy, introducing an additional predictive action to the obfuscation method.

Once the optimal predictive values are computed offline, the optimal obfuscation function could be estimated by using learning techniques with the aim of obtaining low complexity approximations of the optimal solution to be applied online.

Requirements: The applicant must comply to the following requirements:

- PhD in control or any related field
- Experience with nonlinear programming and optimization tools
- Skills with Python (Pandas, Sklearn) and Matlab.

Knowledge on IT, mobile systems and privacy will be appreciated but are not required.

General Information: Town/country : Grenoble, Gipsa-lab research laboratory, France
Starting date : as soon as possible, early 2022
Duration of contract : 1 year
Gross monthly salary (before taxes) : 2 656 €

References

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