Low-Cost Crowdsensing for Indoor Localization

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***Abstract*—**

I. Introduction

II. Related work

III. Localization Model

IV. Low-cost data purchasing problem

In many situations, we could not get access to all the data for both the reason that the data has a cost and our budget is limited. In this section, we will define the problem of thedesigning of the effective mechanism to acquire the RSS information collected by the crowds. However, the mechanism have no means to know either the data is good enough for our localization or there will be a better one coming after. We implement the online machine learning algorithm in our mechanism.

A. Preliminaries and basic assumption

We first define the loss function according to the localization model above.

$$f_t(h_t) =$$

After we acquire the loss function, we give the defininition of the regret function.

$$R(T) = \sum_{t=1}^{T} f_t(h_t) - \min_{h^* \in H} \sum_{t=1}^{T} f_t(h_t^*)$$

where h^* is the optimal choice, causing the least loss in our solution space H. We also make some assumptions for this problem

1)
2)
3)

B. Online Learning Algorithms

We will here use the classical Follow the Regularized Leader(FoRL) algorithm to work as the Online Algorithms. The FoRL has a upper bound of regret of $O(\sqrt{T})$, which ensures that the average regret tends to zero when.There are many kinds of other Online Algorithms which can be found in **??**, etc. The FoRL is described in **??**.

C. Problem formulation

The problem can be described as follows.

1) a sequence of data $d_1, , , d_T$ coming in time $1, , , , , T$ with each data possessing a posted price c_t, $c_t \in [0, M]$.
2) The mechanism post a price p_t according to a probablity $g_t(p_t)$.
3) If the $p > c_t$ agent accepted the price, the mechanism get the loss function and send it back to the OLA and the mechanism will pay for the posted price c_t. If the agent rejected the price, the mechanism would send a null data to the OLA .

D. Importance Weighting technique

In tradational online learning problem, all the data will be used, and we can consider . In out low-cost purchasing problem, not all the loss function are used, and the estimation of loss is $E(\sum_{t=0}^{T} \delta_t f_t) = \sum_{t=0}^{T} q_t f_t$, where δ_t is the function showing whether the data is procured. Noticing that the definition of regret still includes all the loss, in order to get an unbiased estimator, we define

$$f_t(h) = \begin{cases} \dfrac{f_t(h)}{q_t} & ifthedataisaquired \\ 0 & else \end{cases}$$

E. online batch to conversion

We give our final results by averaging every hypothesis h_t acquired in each Details will be added later.

V. The regret minimization senario

In this senario, the mechanism has a fixed budget. The main purpose of the mechanism is to get a high accuracy of localization informaiton, which is consistent with our definition of loss function and regret.

A. Upper bound of regret

We will first find the upper bound of the regret. [] gives a quite well estimation as shown in the following lemma

Lemma 1: The regret bound of problem **??** using the OLA of FoRL is bounded by

$$R(T) = \frac{\beta}{\eta} + E(\sum_{t=1}^{T} \frac{\Delta_{h_t,f_t}^2}{q_t})$$

B. Randomized posted price setting

There still many details be determined here.

C. The optmization problem

Now we can change the problem into a more single form.

$$\min \sum_{t=1}^{T} \frac{\Delta^2_{h_t,f_t}}{q_{c_t}}$$

$$s.t. \sum_{t=0}^{T} \int_{c_t}^{M} x dq(x) \leq B$$

VI. The budget minimization senario

In this senario, the mechanism do not have a certain amount of budget, instead, an upper bound of regret R_{min} is required as a constraint and the optimization target changes to the minimum of budget.

$$\min E(B)$$

$$s.t. R(T) \leq R_{min}$$

VII. Experiments and Simulations

VIII. Conclusion

The conclusion goes here.

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References

[1]