Truthful Spectrum Auction Using Unique Bid Auction To Avoid Collusion

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ABSTRACT

To prevent the dishonest auctioneer may create a bid-rigging with a bidder by colluding with him to falsify the auction result, and shares the extra revenue with him, a paper propose a solution by using a framework with a method-secret sharing[1].According to this framework, we extended a different situation. In English auction, buyers increase the present bid to get the goods determined by their desire to this goods. However, some buyers will secretly set their own buyers in auction to drive up the price venomously. This will make the buyer who had the aspiration of the will of the good have to cost higher price. Although, the purpose of the truthful auction is to maximize the goods' utilities, this behavior is not fair and lambasting. We raised a method: if we reduced the probability of the bad buyers in English auction, then we can decrease the influence from the bad-buyers' attack.

1. INTRODUCTION

To prevent the dishonest auctioneer may create a bid-rigging with a bidder by colluding with him to falsify the auction result, and shares the extra revenue with him, a paper propose a solution by using a framework with a method-secret sharing.According to this framework, we extended a different situation. In English auction, buyers increase the present bid to get the goods determined by their desire to this goods. However, some buyers will secretly set their own buyers in auction to drive up the price venomously. This will make the buyer who had the aspiration of the will of the good have to cost higher price. Although, the purpose of the truthful auction is to maximize the goods' utilities, this behavior is not fair and lambasting. We raised a method: if we reduced the probability of the bad buyers in English auction, then we can decrease the influence from the bad-buyers' attack.

Secret Sharing is our mainly method to distribute the value.Because of its' benefit of Information-theoretically Security and quick calculation.If you did not take certain amount of separate keys,you can not use any way to calculate the keys even if using super-computer. Besides,we use XOR and AND arithmetic operators that it does not take huge charge of calculation.

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First, we implement a environment to English auction by doing loop by Sealed first-price auction.Second, we use our method LHW which is borrowed from unique bid auction, we simulated some situation about bad buyers' attacking.Finally, we calculated the probability of bad buyers after using or method.Below we show our experimental data and our method in detailed.

- Distributed attack: Bad bidder want to make themselves' be unique. They will let their buckets be chosen flat. Because when the other good bidder choose bucket randomly, the bucket will not be no longer unique.
- Stepped attack: In this case, the choose curve is stepped.
- One prize attack: To make themselves (bad bidder) unique, they all may select only one bucket to choose. It will make the choose graph prominent.

2. RELATED WORK

English Auction After the filtering-process, the proportion of the bad bidder will reduce. Then we execute the English Auction. Different from the original English Auction, we make the auction be multi-round. In every round, we select half of bidder to join next round until the numbers of people less than 3. Then the highest bid bidder win auction and the real bid should pay is the second highest bid. Of course, the bid information's transmission still uses the secret sharing method.

Secret Sharing In Multi-round English Auction, we still use the prior essay's method "Secret Sharing" to achieve transmission security. The procedures are shown as follows:

1. We translate the bids to binary.
2. Produce two binary number randomly (a)(b), which length is as long as bid binary.
3. Use these binary bits from (i).(ii) to do XOR estimation, then it produces a new binary number. (c)
4. Send (a)(b)(c) to auctioneer, Seller and buyer respectively.
5. Finally, do XOR estimation step by step,auctioneer, Seller and buyer
6. output:binary translate from original bids

Unique bids auction

Unique bids auction is a type of strategy game, because you have to choose the unique value of buckets. It means that you may consider that is the lowest or highest price other buyers won't choose? Or the middle price buyers won't choose. What's the

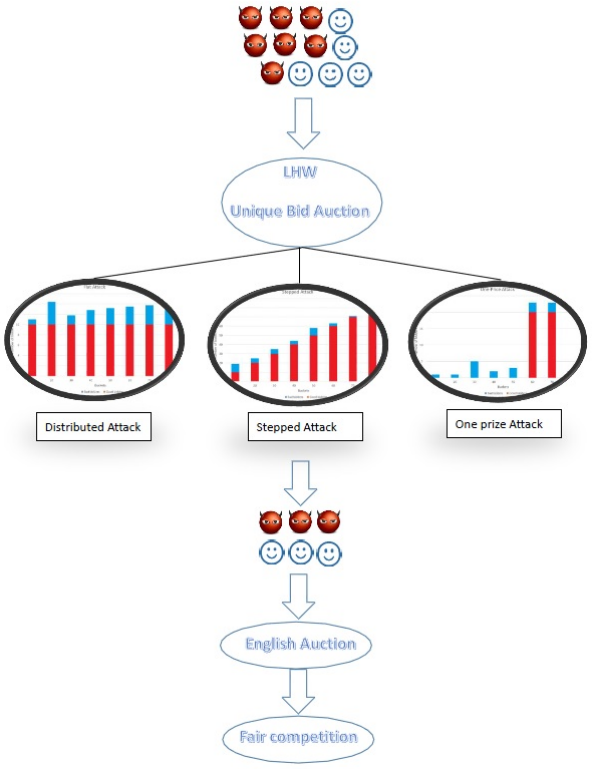

Figure 1: LHW Framwork

rule of a unique bids auction, like the literally mean, after every buyer choosing their price in their mind, auctioneer will take the less bucket buyer choosing. By this auction, we proposed a method called LHW algorithm. And we consider three situation.

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3. SOLUTION IDEA

To prevent the dishonest auctioneer may create a bid-rigging with a bidder by colluding with him to falsify the auction result, and shares the extra revenue with him, a paper propose a solution by using a framework with a method-secret sharing[1].According to this framework, we extended a different situation. In English auction, buyers increase the present bid to get the goods determined by their desire to this goods. However, some buyers will secretly set their own buyers in auction to drive up the price venomously. This will make the buyer who had the aspiration of the will of the good have to cost higher price. Although, the purpose of the truthful auction is to maximize the goods' utilities, this behavior is not fair and lambasting. We raised a method: if we reduced the probability of the bad buyers in English auction, then we can decrease

Algorithm 1: LHW Unique Bid Choosen

Input : Bid values, Bid bucket, the numbers G of good bidder, the numbers B of bad bidder, the numbers C of bucket number
Output: the winning buyer groups and the clearing prices

```
Creat a Hash Table H to store bucket sort result
M = Unique Bid Auction(C,G,B) //Sort and return max,min bucket
H = max(H),m = min(H) //store max,min value bucket
T = Attack detection(H) //return attack type
if T=flat then
    return M;
else
    return m;
end
```

the influence from the bad-buyers' attack. Unique bids auction[2] is a type of strategy game, because you have to choose the unique value of buckets. It means that you may consider that is the lowest or highest price other buyers won't choose? Or the middle price buyers won't choose. What's the rule of a unique bids auction, like the literally mean, after every buyer choosing their price in their mind, auctioneer will take the less bucket buyer choosing. By this auction, we proposed a method called LHW algorithm. And we consider three situation.

- Distributed attack: In this case, we will choose the most be-chosen bucket's selector to be the winner.
- Stepped attack: In this case, the choose curve is stepped.
- One prize attack: In this case, we select the lowest be-chosen bucket's to be the winner.

4. SOLUTION

To solve the problem of bidder's collusion, we use Unique Bid Auction as the pre-job. After this process, the proportion of the bad bidder will decrease. This phenomenon will make the Auction be more fair. In this section, we will introduce the detail issues respectively as follows.

Framework In our framework, we set bad buyers and good buyers in much proportion.After our method, we reduced the proportion of bad buyers in any case.We implement three situation: Distributed attack, Stepped attack, One prize attack. Each solution correspond to each case, we can see the implementation result below.

LHW Unique Bid Chosen Unique Bid Auction is a kind of Auction which is different from others. The Auction's winner is not the highest bid which bidder bided but the unique bid. At first, auction set numbers of buckets which represent the bid (Bucket 1 represent 10, bucket 2 represent 20...). Bidder will choose a bucket as his bid choice. Finally, every bidder will have its bucket set, and every bucket will have multi-choose or not to be chosen. Then the winner has some choices to be selected (the highest unique prize or the lowest unique prize etc...). We design a better method algorithm.1 to reduce the proportion of bad bidders, called Fixed Unique Bid Auction(Algorithm.1). Bad bidder will make some trick to pass the filter-process. We describe three attacks as follows:

- Distributed attack:In this case, we will choose the most be-chosen bucket's selector to be the winner.

- Stepped attack: In this case, the choose curve is stepped, we will choose the lowest unique bucket to be the winner. (It seldom happen, because it will obviously reduce proportion of bad bidder themselves)

- One prize attack:In this case, we select the lowest be-chosen bucket's to be the winner.

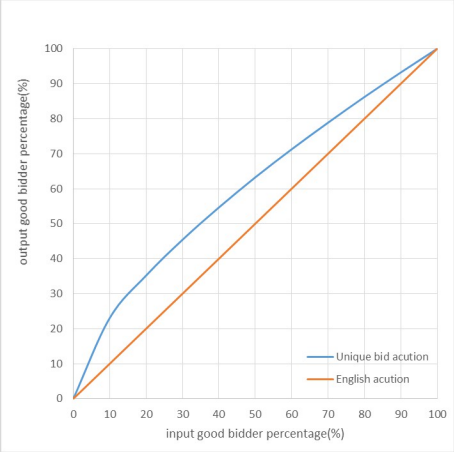

Figure 2: LHW unique bid auction and English auction under flat attack. (a) A comparable result of unique bid auction and English auction under flat attack. Note that the total number of bidders is 100.

5. SIMULATION

As our implementations for LHW unique bid auction exactly follow the procedure of original auction mechanisms, the auction related performance is equal to the traditional ones roughly. As a result, in this section, we focus on the analysis and evaluation of some variable, such as bucket number, the proportion of good bidders and bad bidders.

A.experiment setting

We implement LHW unique bid auction using Java, and write down logs to save our result as a csv file. Continuously, we check out the csv file and convert data to a diagram. In LHW unique bid auction implementation, we have some variables, such as number of bucket, the proportion of good or bad bidders and dense type. After clearly define our variables, we will let each variable of as a fixed constant by turns. Every turns will run 10000 times and get the average as result. We will give some explanation for the experiment result which will be shown in next section. For LHW unique bid auction implementations, the dominant computation component is bid counting, whose complexity is , where is the number of bids counted. In the other hand, LHW unique bid auction is like the bucket sort, so the complexity is of course linear time. In conclusion, we have known the performance of LHW unique bid auction is really faster than other auctions.

B. experiment result

In this section, we consider the number of bucket and make it as fixed constant. We can find that English Auction result shows that the same proportion of input and output of good bidders, as shown in Fig.2. Because of our mechanism, when we get the distribution of bids and the distribution is too flat, we take out the buckets which has the highest number of bidders. Conversely, if there is a

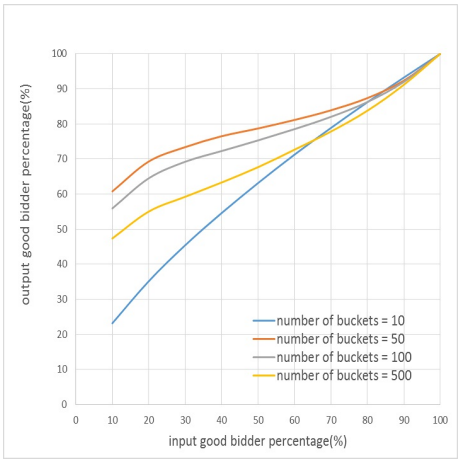

Figure 3:

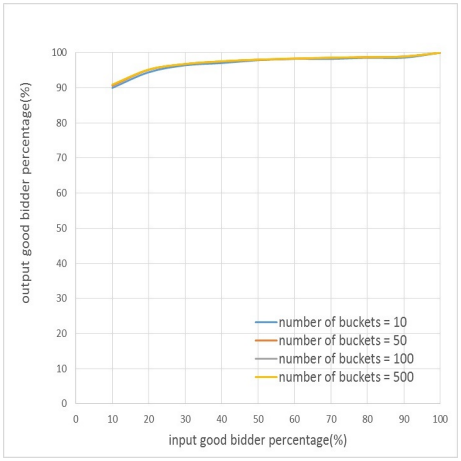

Figure 4:

one-price attack, we will take out the lowest ones. Fig.3.4.5 shows that how many good bidders will survive under three type of attack using LHW unique bid auction. Fig.3 is the result of flat attack, it shows that the lower number of buckets, the higher probability of the proportion of good bidder can go to the second stage. It is obviously that flat attack works when bad bidders are more than buckets because there must be at least one bad bidder in each buckets. As a result, when bad bidders are less than buckets, we have chances to get a bucket without any bad bidder. Fig.4 shows result of LHW unique bid auction under one-price attack. We can see all four lines are crowed together and also be allocated in higher percentage of output good bidders. Therefore, we can conclude that one-price attack is not work very well in LHW unique bid auction. Fig.5 shows that stepped attack works well as the number of buckets is 10. Notice that our total number of bidders is 100. So, if the number of buckets is greater than the number of bad bidders, of course bad bidders are not enough to fill up all of buckets. Consequently, when the number of buckets is greater than 10, bad bidders are not enough to do stepped attack. That is the reason why there is only one line, which is the number of buckets is 10, represents that stepped attack works better than other lines. However, LHW unique bid auction is not knocked down by stepped attack.

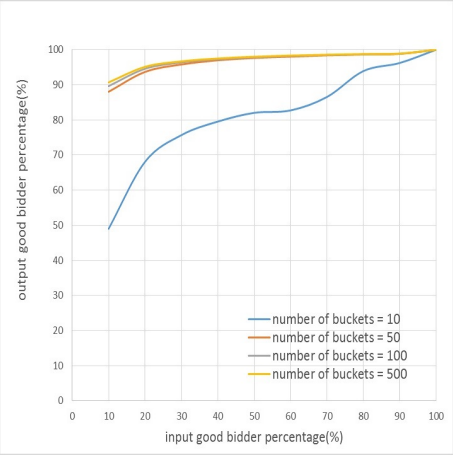

Figure 5: Fig.3.4.5 comparable result of different number of buckets under flat, one-price, stepped attack. Also, there are three different number of buckets, respectively, 10, 50, 100 and 500.

6. CONCLUSION

In this essay, we assume that there is an attack on our auction which is given a certain percentage of bad bidders. Our scenery is that bad bidders have colluded with the auctioneer. These bad bidders will bid a price which is said beforehand. To decreasing the attack success probability, we proposed use LHW unique bid auction before second stage auction. Specifically, LHW unique bid auction reveals nothing about the bidders' information except the bids distribution. Furthermore, we have implemented LHW unique bid auction in Java and have theoretically and experimentally shown that LHW unique bid auction achieves decreasing the probability of attack success.