False-name Bids in Combinatorial Auctions

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In Internet auctions, it is easy for a bidder to submit multiple bids under multiple identifiers (e.g., multiple e-mail addresses). If only one good is sold, a bidder cannot make any additional profit by using multiple bids. However, in combinatorial auctions, where multiple goods are sold simultaneously, submitting multiple bids under fictitious names can be profitable. A bid made under a fictitious name is called a *false-name bid*. This article gives a brief introducion on false-name bids in combinatorial auctions.

Categories and Subject Descriptors: I.2.11 [**Artificial Intelligence**]: Distributed Artificial Intelligence—*Multi-agent systems*

General Terms: Theory, Economics

Additional Key Words and Phrases: Combinatorial Auction, Mechanism Design

1. MODEL OF FALSE-NAME BIDS

Although the Internet provides an excellent infrastructure for executing combinatorial auctions, we must consider the possibility of new types of cheating. For example, a bidder may try to profit from submitting false bids under fictitious names such as multiple e-mail addresses. Such an action is very difficult to detect since identifying each participant on the Internet is virtually impossible. We call a bid made under a fictitious name a *false-name bid*.

False-name bids are modeled as follows.

—Each bidder can use multiple identifiers.

—Each identifier is unique and cannot be impersonated, i.e., a bidder cannot use identifiers that belong to other bidders.

—Nobody (except the owner) knows whether two identifiers belongs to the same bidder or not.

The goal is to design a *false-name-proof protocol*, i.e., a protocol in which using false names is useless, thus bidders voluntary refrain from using false names.

The problems resulting from collusion have been discussed by many researchers. Compared to collusion, a false-name bid is easier to execute on the Internet since obtaining additional identifiers, such as another e-mail address, is quite inexpensive. False-name bids can be considered as a very restricted subclass of collusion, where bidder i can collude with other bidders only if these bidders are not interested in participating the auction initially. These bidders act in behalf of bidder i and get some side payment.

2. VULNERABILITY OF GVA

The Generalized Vickrey Auction (GVA) protocol (a.k.a. Vickrey-Clarke-Groves mechanism) is (dominant strategy) incentive compatible, i.e., for each bidder, truth-telling is a dominant strategy (a best strategy regardless of the actions of other bidders) if false-name bids are not possible. However, when false-name bids are possible, truth-telling is no longer a dominant strategy, i.e., the GVA is not false-name-proof.

Let us consider the following situation.

Example 2.1. *Assume there are two goods a and b, and three bidders, bidder 1, 2, and 3. The evaluation value for a bundle is determined as follows.*

	$\{a\}$	$\{b\}$	$\{a, b\}$
bidder 1	*\$6*	*\$0*	*\$6*
bidder 2	*\$0*	*\$0*	*\$8*
bidder 3	*\$0*	*\$5*	*\$5*

By using the GVA, good a is allocated to bidder 1, and b is allocated to bidder 3. Bidder 1 pays \$3 and bidder 3 pays \$2.

Let us consider another situation.

Example 2.2. *Assume there are only two bidders, bidder 1 and 2. The evaluation value for a bundle is determined as follows.*

	$\{a\}$	$\{b\}$	$\{a, b\}$
bidder 1	*\$6*	*\$5*	*\$11*
bidder 2	*\$0*	*\$0*	*\$8*

In this case, bidder 1 can obtain both goods, but he/she is required to pay \$8, since if bidder 1 does not participate, the social surplus would have been \$8. When bidder 1 does participate, bidder 1 takes everything and the social surplus (excluding bidder 1) becomes 0. Thus, bidder 1 needs to pay the decrease in the social surplus, i.e., \$8.

However, bidder 1 can use another identifier, namely, bidder 3 and create a situation identical to Example 2.1. Then, good a is allocated to bidder 1, and b is allocated to bidder 3. Bidder 1 pays \$3 and bidder 3 pays \$2. Since bidder 3 is a false name of bidder 1, bidder 1 can obtain both goods by paying \$3+\$2=\$5. Thus, using a false name is profitable for bidder 1.

3. KEY RESULTS

The effects of false-name bids on combinatorial auctions are analyzed in [Yokoo et al. 2004]. The obtained results can be summarized as follows.

—As shown in the above example, the GVA protocol is not false-name-proof.

—There exists no false-name-proof combinatorial auction protocol that satisfies Pareto efficiency.

—If a surplus function of bidders satisfies a condition called *concavity*, then the GVA is guaranteed to be false-name-proof.

Also, a series of protocols that are false-name-proof in various settings have been developed: combinatorial auction protocols [Yokoo et al. 2001a; Yokoo 2003; Yokoo et al. 2006], multi-unit auction protocols [Iwasaki et al. 2005; Terada and Yokoo 2003; Yokoo et al. 2001b], double auction protocols [Sakurai and Yokoo 2002; 2003; Yokoo et al. 2005], and combinatorial procurement auctions [Suyama and Yokoo 2005].

Furthermore, in [Yokoo 2003], a distinctive class of combinatorial auction protocols called a Price-Oriented, Rationing-free (PORF) protocol is identified. The description of a PORF protocol can be used as a guideline for developing strategy/false-name proof protocols.

In [Ausubel and Milgrom 2005], several limitations of the GVA including the vulnerability to false-name bids are discussed. Also, in [Rastegari et al. 2007], the connection between false-name-proofness and another property called *revenue monotonicity* is discussed.

4. OPEN PROBLEMS

It has been shown that there exists no false-name-proof protocol that is Pareto efficient. Thus, it is inevitable to give up the efficiency to some extent. However, no theoretical bound on the efficiency loss is obtained so far. Also, the efficiency loss of existing false-name-proof protocols can be quite large. More efficient false-name-proof protocols in various settings are needed.

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