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#1569420757: *A Potential Function View of Information Theoretic Interference Games*

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Conference and *track*		**2011 IEEE International Symposium on Information Theory** - *2011 IEEE International Symposium on Information Theory*

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Property		Value
Presenter		presenter not specified
Registration	➕	
Category		Eligible for ISIT Student Paper Award
Title		*A Potential Function View of Information Theoretic Interference Games*
Abstract		Recently, Berry-Tse introduced a model for information theoretic games on interference channels, which combines game theory and information theory to analyze the interaction of selfish users. The fundamental quantity in such games is the Nash equilibrium region which has been characterized in several specific interference channels. This paper uses the game theoretic techniques of potential functions to study this region for general K user linear deterministic interference channels. In particular, it is shown that the Nash equilibrium region is non-empty for any such K user interference channel.
Keywords		information theory; game theory; interference games; potential functions; weakly acyclic games;
Topics		Multiple terminal information theory; Emerging field or novel application
Session		The program is not yet visible (tpc)
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Personal notes

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Reviews

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3 Reviews

Review 1 (Reviewer D)

Importance	Technical Level	Novelty	Presentation	Recommendation

Average Importance (3)   Good technical level (4)   Very Novel (4)   Excellent (5)   Strongly Recommend (5)

Strengths (What are the key strengths of this paper?)

A Potential Function View of Information Theoretic
Interference Games

In this paper the authors tackle the problem of existence of Nash equilibria in the interference channel games, where the user action set is made of information theoretic parameters (bits encoded in a bloc etc). In order to do this, they prove the game to be a weakly acyclic one" and, successively, a potential one. The work is quite different from typical ones in the Game theoretic modeling of Interference Channel (see for instances: Gesualdo Scutari, Daniel P. Palomar, and Sergio Barbarossa, "Competitive Design of Multiuser MIMO Systems based on Game Theory: A Unified View," IEEE Journal on Selected Areas in Communications: Special Issue on Game Theory, vol. 25, no. 7, pp. 1089-1103, Sept. 2008; Complete Characterization of the Pareto Boundary for the MISO Interference Channel; Rose, L. and Perlaza, S. M., and Debbah, M., "On the Nash Equilibria in Decentralized Parallel Interference Channels", in proc. of the IEEE ICC 2011 Workshop on Game Theory and Resource Allocation for 4G, Kioto, Japan, June, 2011) and a comparison between those different visions could be interesting. The paper is very well written and readable, and looks like a nice extension of the work of Berry and Tze.

Weaknesses (What are the major weaknesses of this paper?)

The only problems the reviewer is able to find are:
- a small typo "a posterior" instead of "a posteriori" in the first page
- the absence of a simulation section (with an algorithmic part) for reaching the NE...
- the absence of the study of multiplicity of the Nash equilibriums.

Review 2 (Reviewer E)

Importance	Technical Level	Novelty	Presentation	Recommendation
Very Important (4)	Good technical level (4)	Average Novelty (3)	Good (4)	Strongly Recommend (5)

Strengths (What are the key strengths of this paper?)

This paper considers an interesting problem on the non-emptiness of the Nash equilibrium region for linear deterministic interference channels. The Nash equilibrium region is a game-theoretic analogue of the capacity region and was introduced by Berry and Tse. In prior work, the non-emptiness of this region has primarily been shown for 2-user games and some special cases of K user linear deterministic interference channels. This paper extends that work to show that the Nash equilibrium region is non-empty for all K user linear deterministic interference channels. This is an important result, as it significantly expands the applicability of the NE region idea, which is a critical theoretical idea for understanding the capacity of non-cooperative systems.

The paper is well-written ad relatively easy to read, considering the relatively high technical level of the topic. The results appear to be fundamentally sound, and the proof is established on the basis of a relatively novel technique that builds on the idea of weakly acyclic games.

Weaknesses (What are the major weaknesses of this paper?)

The connection to potential game theory is a bit strained as in every other context that the reviewer is aware of, the potential function must be a real-valued function. As the lexiographic ordering imposed on the "potential function" makes clear, the goal here is not really to define a potential function at all, but to define a sort-of "social preference relationship" that has some of the properties of a potential function. Thus the potential function idea is applied more by analogy than directly, and the reviewer is a bit uncertain as to whether this analogy adds clarity or confusion!

The linear deterministic channel, at the heart of the key result of this paper, is insufficiently described in the paper.

Comments and Recommendation (Please give the reasoning for your overall recommendation and any additional comments you wish to add.)

Overall, I think this is a strong paper that proves an interesting and important result. The result is narrow and theoretical, of course, as this is to some extent the nature of progress in information theory. But nevertheless represents significant progress over prior work and adds marked significance to the concept of the Nash equilibrium region (by proving that this concept can be generalized in a non-trivial way beyond 2-person games, at least for some channels).

Very minor comments:

* When "K user" is used as an adjective, it is usually hyphenated, e.g. a "K-user linear deterministic interference channel."

* In the first sentence of the second paragraph of the Introduction, "exists" should be "exist."

Student Paper Award (This paper is eligible for the student paper award. Do you think it would rank among the top ten papers out of the 500 submitted papers in that category? If so, explain why.)

As this is the first time that I have reviewed a paper for ISIT, it is difficult for me to answer a question regarding the relative rank of this paper. I do believe, however, that it is a *very* good paper and that it should certainly be considered for an award.

Review 3 (Reviewer B)

Importance	Technical Level	Novelty	Presentation	Recommendation
Very Important (4)	Good technical level (4)	Very Novel (4)	Average (3)	Recommend (4)

Strengths (What are the key strengths of this paper?)

This paper attempts to answer an ambitious question: In an interference channel where each user tries to maximize its rate subject to probability of error constraints, does a competitive Nash equilibrium always exists? The paper tries to answer this question without any assumption on coding strategies. But it succeeded only for the linear deterministic model.

Weaknesses (What are the major weaknesses of this paper?)

It seems to me that the restriction to linear deterministic model essentially restricts the class of input strategies to Gaussian strategies, where the inputs are represented by bits or in terms of SNRs. The paper made a point that previous studies restrict to Gaussian only. But is it really resolved in the present paper? I am not so sure.

The usefulness of the results contained in this paper very much relies on how feasible it is to be generalized to the Gaussian case -- a point which

1 Summary review by TPC member

Review 1 (Reviewer A)

TPC recommendation

Strong accept (5)

TPC Recommendation Justification (Please give a justification for your recommendation, especially if the review scores vary widely or your recommendation differs significantly from those of the reviewers.)
Two reviewers give a strong accept and one gives an accept.

Student Paper Award (This paper is eligible for the student paper award. The TPC needs to identify 10-15 semifinalists for the award from among the 500 submitted eligible papers. Later the IT Society Awards committee will select up to three winners. If you think this paper is worthy of the award, please send a one page nomination to the TPC cochairs at isit2011@eng.tau.ac.il with "STUDENT AWARD NOMINATION" in the subject header. The TPC co-chairs and IT Society Awards committee will have access to the papers, reviews (including your TPC summary review) and the nominations of the finalists. (You need not write anything in the box here.))
seems like a contender.

Discussion

Not a reviewer.
Apr 16, 2011 04:23

A TPC MEMBER SUBMITTED THE FOLLOWING NOMINATION OF THIS PAPER FOR THE STUDENT PAPER AWARD:
My recommendation is primarily based on three reviews I have gotten for the paper: 2 reviewers recommend a strong accept, and the third recommends an
accept.

The paper builds on an earlier work of Berry and Tse that introduced a model for information theoretic games on (linear deterministic) interference
channels.
A key quantity in such games is the Nash equilibrium region which has been characterized for several specific interference channels in prior work. In
this paper,
the authors use the technique of potential functions from game theory to show that the Nash equilibrium region is non-empty for any K user linear
deterministic
interference channel. The results in this paper are partly inspired by related game-theoretic results in acyclic games.

The paper is clearly written and well-motivated. I am not an expert in the area, but based on the reviews from researchers working in the area, it
seems that the paper
constitutes an important advance in the area of information theoretic games on interference channels. It also seems that the techniques used by the
authors are
quite different from other prior work on game-theoretic analysis of interference channels. On the other hand, the results are limited to the linear
deterministic
channel.