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#1569420177: *Covering Point Patterns*

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Presenter		presenter not specified
Registration		
Category		Not eligible for student award
Title		*Covering Point Patterns*
Abstract		An encoder observes a point pattern---a finite number of points in the interval $[0,T]$---which is to be described to a reconstructor using bits. Based on these bits, the reconstructor wishes to select a subset of $[0,T]$ that contains all the points in the pattern. It is shown that, if the point pattern is produced by a homogeneous Poisson process of intensity λ, and if the reconstructor is restricted to select a subset of average Lebesgue measure not exceeding DT, then, as T tends to infinity, the minimum number of bits per second needed by the encoder is $-\lambda\log D$. It is also shown that, as T tends to infinity, any point pattern on $[0,T]$ containing no more than λT points can be successfully described using $-\lambda \log D$ bits per second in this sense. Finally, a Wyner-Ziv version of this problem is considered where some of the points in the pattern are known to the reconstructor.
Topics		Source coding; Shannon theory
Session		The program is not yet visible (tpc)
DOI		
Status		accepted

Review manuscript	Document (show)	Pages	File size	Changed	MD5	Similarity score
	PDF	5	345,808	February 15, 2011 08:58:38 EST	e0d44caa2c388b7c60903d2f49c5eeaf	14

Final manuscript		Can upload 5 pages until May 31, 2011 00:00:00 EDT.

Personal notes

Reviews

You are a TPC member for this conference.

3 Reviews

Review 1 (Reviewer C)

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

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

In this work the authors derive the rate-distortion function related to the covering of a homogeneous Poisson process -- this is done for the regular rate-distortion setting as well as the Wyner-Ziv setting.
They show the extermal property that the Poisson process is the most difficult to cover.

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

I don't see any major weakness.

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

The authors result joins related results on the study of the rate-distortion function of the Poisson process under different distortion measures e.g. [7] as well as Verdu's work "The exponentional distribution in Information Theory" [1996]. Interestingly, the rate distortion function in these cases is the same.
Also, the Wyner-Ziv result which says that knowing the points at the reconstrur only is as good as knowing them also at the encoder reminds the same property which holds in the Gaussian setting.

Review 2 (Reviewer D)

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

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

this paper gives en elegant solution to an interesting problem formulation. the presentation of the results is concise and clear.

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

the authors could perhaps motivate the problem a bit more, and perform a broader literature search in this class of problems to give a better perspective on the importance of this problem and how it fits in with known results.

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

the authors consider the problem of describing (using bits), a point pattern observed in an interval (under a cost constraint at reconstructor). The result is quite elegant and the presentation is very friendly. One small recommendation would be to include footnote 2 as part of the text and emphasize that all subsequent proofs are based on this modification. Also, to give the problem more perspective, the introduction could include additional literature survey and problem motivation. I would strongly recommend this work for ISIT2011

Review 3 (Reviewer B)

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

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

This is a very cute paper. The authors consider the problem of "covering" a point process. In short, a point process of rate lambda is observed over the [0,T] interval. An encoder maps them to TR bits. Then, a decoder takes the TR bits and reconstructs a {0,1}-valued, continuous time waveform. A key constraint that must hold is that the output waveform must be 1 when the point process had an arrival occur. The distortion is the fraction of the [0,T] interval over which the output reproduction is 1.

It is neat that the authors have an exact characterization of R(D), and it is
R(D,\lambda)=-\lambda \log(D)
for D \in [0,1]. This has been characterized in many other papers for Poisson processes and different distortion measures.

The authors have also demonstrated:
- R(D,\lambda) is achievable on any point process that is of rate lambda in a certain sense (equation 9).
- R(D,\lambda) is achievable adversarially for which at time T the input source has at most \lambda T arrivals (equation 10).
- knowing a fraction p of the points at the decoder only is as good as knowing them also at the encoder: R(D,(1-p)\lambda) is achievable. This is analogous to a Wyner-Ziv like statement.

The proofs are all very simple and they in essence map the problem back to a problem involving R(D) coding in discrete time with IID inputs and time-invariant distortion measures. This insight by the authors is particularly noteworthy. It leverages Wyner's insight of reducing the peak-limited Poisson channel to a DMC.

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

Why is this distortion measure relevant? It is cute because it provides a very natural way to map this back to an discrete time R(D) problem with IID inputs and a time-invariant distortion measure. Are there any other reasons beyond this that this distortion measure is useful? Anything practical? Or is it all from the insight from Wyner and the Poisson channel? Elaborating upon this would be more insightful to the reader.

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

see above

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.)

With such consistently high recommendations by all three esteemed reviewers I had to read this paper myself and also utterly enjoyed it. The problem formulation is elegant, and the solution is given completely in a clean, crisp, and sound fashion.

Discussion

Not a reviewer. Apr 16, 2011 04:19	A TPC MEMBER SUBMITTED THE FOLLOWING NOMINATION OF THIS PAPER FOR THE STUDENT PAPER AWARD: The paper considers an elegant, timely, and in my view naturally practically motivated problem of lossy compression of point processes. The problem formulation is elegant. A novel and natural distortion criterion is suggested. The solution is given completely in a clean, crisp, and sound fashion.