

Capacity of Multi-antenna Gaussian Channels (I. E. Telatar, 1999)

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1 Notation used in the course

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Notation for sets, scalars and vectors

- Lowercase letters, x, y, \dots are used for constants and values of random variables.
- Sequences or column vectors are $x_i^j = (x_i, x_{i+1}, \dots, x_j)$. In case $i = 1$ then $x^j = (x_1, x_2, \dots, x_j)$.
- Let $\alpha, \beta \in [0, 1]$. Then $\bar{\alpha} = (1 - \alpha)$ and $\alpha * \beta = \alpha\bar{\beta} + \beta\bar{\alpha}$.
- Calligraphic letters $\mathcal{X}, \mathcal{Y}, \dots$ are used for finite sets and $|\mathcal{X}|$ denotes the cardinality of the set \mathcal{X} .
- $[i : 2^a] = \{i, i + 1, \dots, 2^{\lceil a \rceil}\}$, where $\lceil a \rceil$ is the smallest integer $\geq a$.

Notation for probability and random variables (I)

- The probability of an event \mathcal{A} is $P(\mathcal{A})$ and the conditional probability of \mathcal{A} given \mathcal{B} is $P(\mathcal{A}|\mathcal{B})$.
- Uppercase letters, X, Y, \dots are used for random variables.
- Random variables may take values from finite sets $\mathcal{X}, \mathcal{Y}, \dots$ or from the real line \mathbb{R} .
- $X = \emptyset$ means that X is a degenerate random variable (a constant).
- The probability of the event $X \in \mathcal{A}$ is $P\{X \in \mathcal{A}\}$
- Sequences or column vectors of random variables are $X_i^j = (X_i, X_{i+1}, \dots, X_j)$. In case $i = 1$ then $X^j = (X_1, X_2, \dots, X_j)$.

Notation for probability and random variables (II)

- $X^n \sim p(x^n)$ means that $p(x^n)$ is the probability mass function (pmf) of the discrete random vector X^n .
- $X^n \sim f(x^n)$ means that $f(x^n)$ is the probability density function (pdf) of the continuous random vector X^n .
- $(X^n, Y^n) \sim p(x^n, y^n)$ means that $p(x^n, y^n)$ is the joint pmf of X^n and Y^n .
- Given a random variable X , the expected value of a function $g(X)$ is denoted by $E_X(g(X))$ or simply $E(g(X))$.

Notation for probability and random variables (and III)

- $X \sim \text{Bern}(p)$ means X is a Bernoulli random variable with parameter $p \in [0, 1]$, i.e., $X = 1$ with probability p and $X = 0$ with probability $1 - p$.
- $X \sim \text{Unif}(\mathcal{A})$ means X is a discrete uniform random variable over the set \mathcal{A} .
- $X \sim \text{Unif}[i : j]$ for integers $j > i$ means X is a discrete uniform random variable over $[i : j]$.
- $X \sim \text{Unif}[a, b]$ for $b > a$ means X is a continuous uniform random variable over $[a, b]$.
- $X \sim \text{N}(\mu, \sigma^2)$ means X is a Gaussian random variable with mean μ and variance σ^2 .

- The function $\log p$ is assumed to be the base 2 logarithm function of p .
- The binary entropy function: $H(p) = -p \log p - \bar{p} \log \bar{p}$ for $p \in [0, 1]$.
- The Gaussian capacity: $\mathcal{C}(x) = \frac{1}{2} \log(1 + x)$, for $x \geq 0$.
- $[x]^+ = \max\{x, 0\}$.

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Remark

Sample text

Important theorem

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Examples

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$$E = mc^2$$

- First item
- Second item

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