Continuous Channel

A continuous information source produces a time varying signal $x(t)$. It is assumed that $x(t)$ has a finite Bandwidth i.e. $x(t)$ is completely characterised by its periodic sample values.

the average information per sample value of $x(t)$.

$$H(X) = \int_{-\infty}^{\infty} f(x) \log \frac{1}{f(x)} \, dx$$

$f(x)$: probability density function.

$H(X)$: differential entropy of X.

$H(X)$ can be positive, zero or negative depending upon the probability density function of the source

$$H(Y) = -\int_{-\infty}^{\infty} f_Y(y) \log f_Y(y) \, dy.$$

$$H(X|Y) = -\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f_{XY}(x, y) \log_2 f_X(x|y) \, dx \, dy$$

$$H(Y|X) = -\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f_{XY}(x, y) \log_2 f_Y(y|x) \, dx \, dy.$$

$$H(XY) = -\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f_{XY}(x, y) \log_2 f_{XY}(x, y) \, dx \, dy.$$

Mutual Information of continuous channel

1. $I(X;Y) = H(X) - H(X|Y)$
2. $I(X;Y) = H(Y) - H(Y|X)$