Delta modulation DM

* DM is a simple modulation used to transmit on bit per sampling frequency
* In DM the analog signal is oversampled to increase the correlation between adjacent samples
* Correlation is used to measure the similarity between different samples
* Correlation is given mathematically by the following equation

$$R_{xx}(\tau) = \int_{-\infty}^{\infty} x(t)\, x(t+\tau)\, dt$$

* oversampling is done to permit the use of simple quantization strategy

Principle of operation of DM

* The principle of operation of the DM can be best illustrated by the following diagram

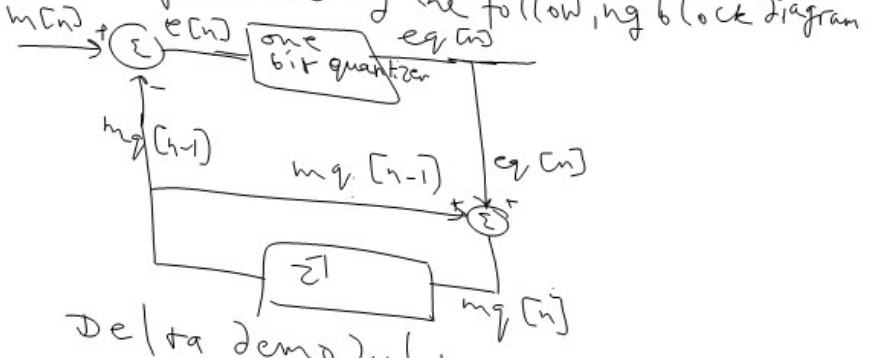
* In DM we take a current from the analog signal and compare with the previous sample
* If the current sample is greater than the previous sample, then the modulator generate +Δ (logic 1)
* If the current sample is less than the previous sample then the modulator generates -Δ (logic 0)
* The discrete time equations which describes the DM are given by

$$e[n] = m[n] - m_q[n-1]$$
$$e_q[n] = \Delta\, Sgn(e[n])$$
$$m_q[n] = m_q[n-1] + e_q[n]$$

$e[n]$ is the difference between between the current sample $m[n]$ and previous quantized sample $m_q[n-1]$

$m_q[n]$ is the quantized version of our current sample

* The previous equations can be represented by the following block diagram



Delta demodulator

* The delta demodulator constructs the original signal by summing the received bit stream as described by the following equation

$$m_q[n] = \Delta \sum_{i=1}^{n} Sgn(e[i])$$
$$= \sum_{i=1}^{n} e_q[i]$$