

ELC 406A

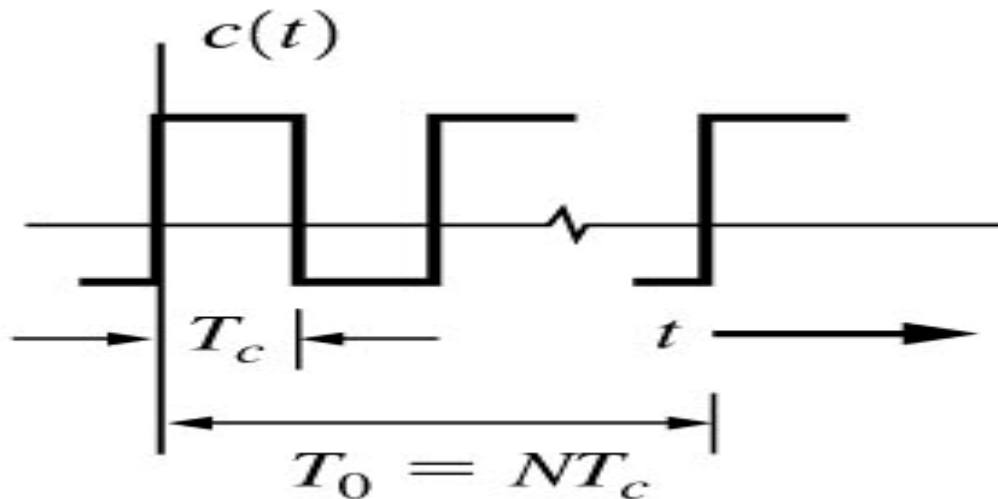
Advanced Digital Communication

Lecture 3

Pseudo-Random Sequence Generator

PN sequence

- ◆ In DS-SS and FH-SS the spectrum is spreaded by means of a **pseudo-white** or **pseudo-noise** code.



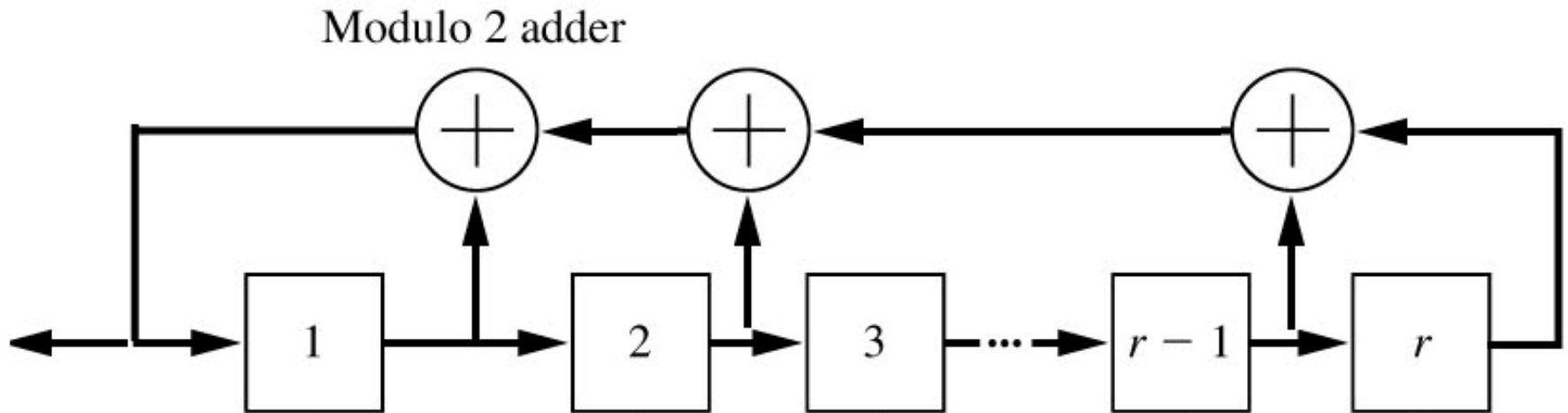
Mathematical Note

- ◆ A finite field is an algebraic field with finite number of “Symbols”
- ◆ Define the Finite field $\{0,1\}$
- ◆ Addition = XOR gate
- ◆ Multiplication = AND gate
- ◆ $\{1,,1,0,1,1\} = 1+1.D+0.D^2+1.D^3+1.D^4$

PN sequence

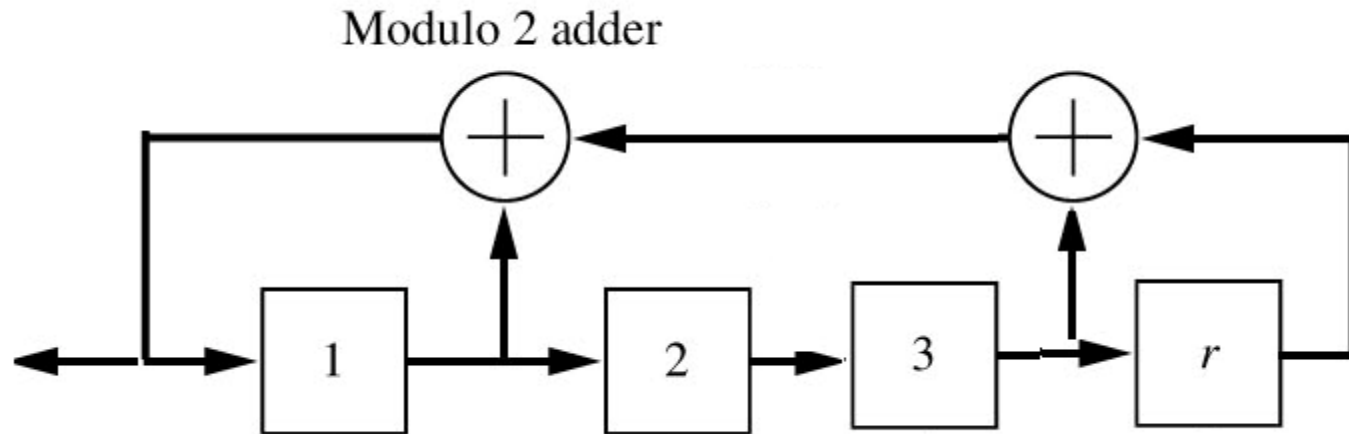
- ◆ Instead of using a memory to maintain the code we use a Hardware to generate the code.
- ◆ It is a linear feedback shift register defined by a generator polynomial

Sequence Generator



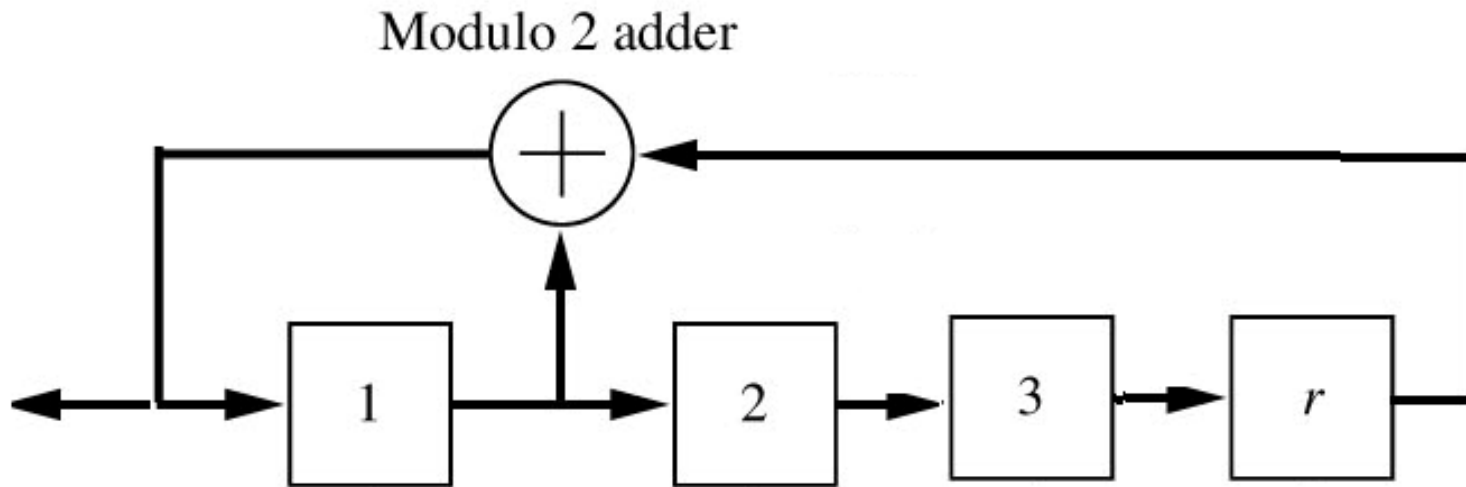
$$g(D) = g_0 + g_1 \cdot D^1 + g_2 \cdot D^2 + g_3 \cdot D^3 + \dots + g_r \cdot D^r$$

Sequence Generator: Example1



$$g(D) = 1 + D^1 + D^3 + D^4$$

Sequence Generator: Example2



$$g(D) = 1 + D^1 + D^4$$

Maximum Length Sequence

- Sequence length = $N = 2^r - 1$
- Number of '1' = $(N+1)/2 = 2^{r-1}$
- Number of '0' = $(N-1)/2 = 2^{r-1} - 1$
- Shift and Add property:

$$c(D) + c(D+1) = c(D+1)$$

- Window property:

111101011001000

Maximum Length Sequence

Run Property:

1111 0 1 0 11 00 1 000

1 run of '1' of length 4

1 run of '0' of length 3

1 run of '1' & '0' of length 2

1 run of '1' & '0' of length 1

Maximum Length Sequence

Run Property:

for a maximum length sequence:

1 run of '1' of length r

1 run of '0' of length $r-1$

1 run of '1' & '0' of length $r-2$

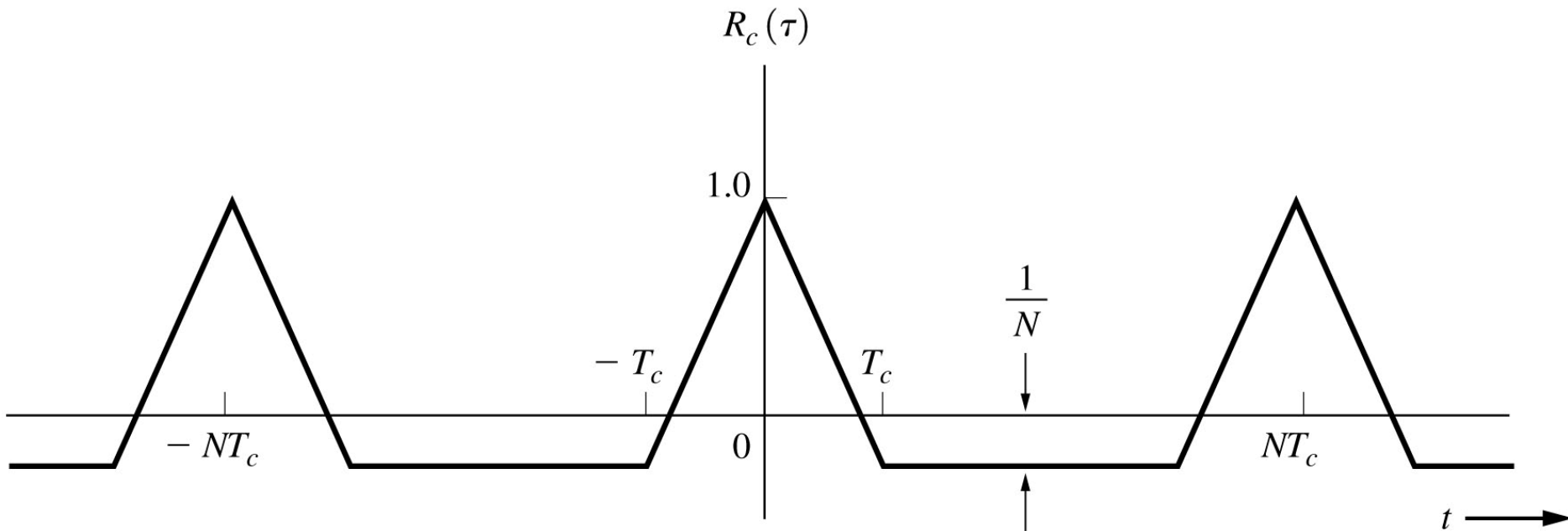
2^1 run of '1' & '0' of length $r-3$

2^2 run of '1' & '0' of length $r-4$

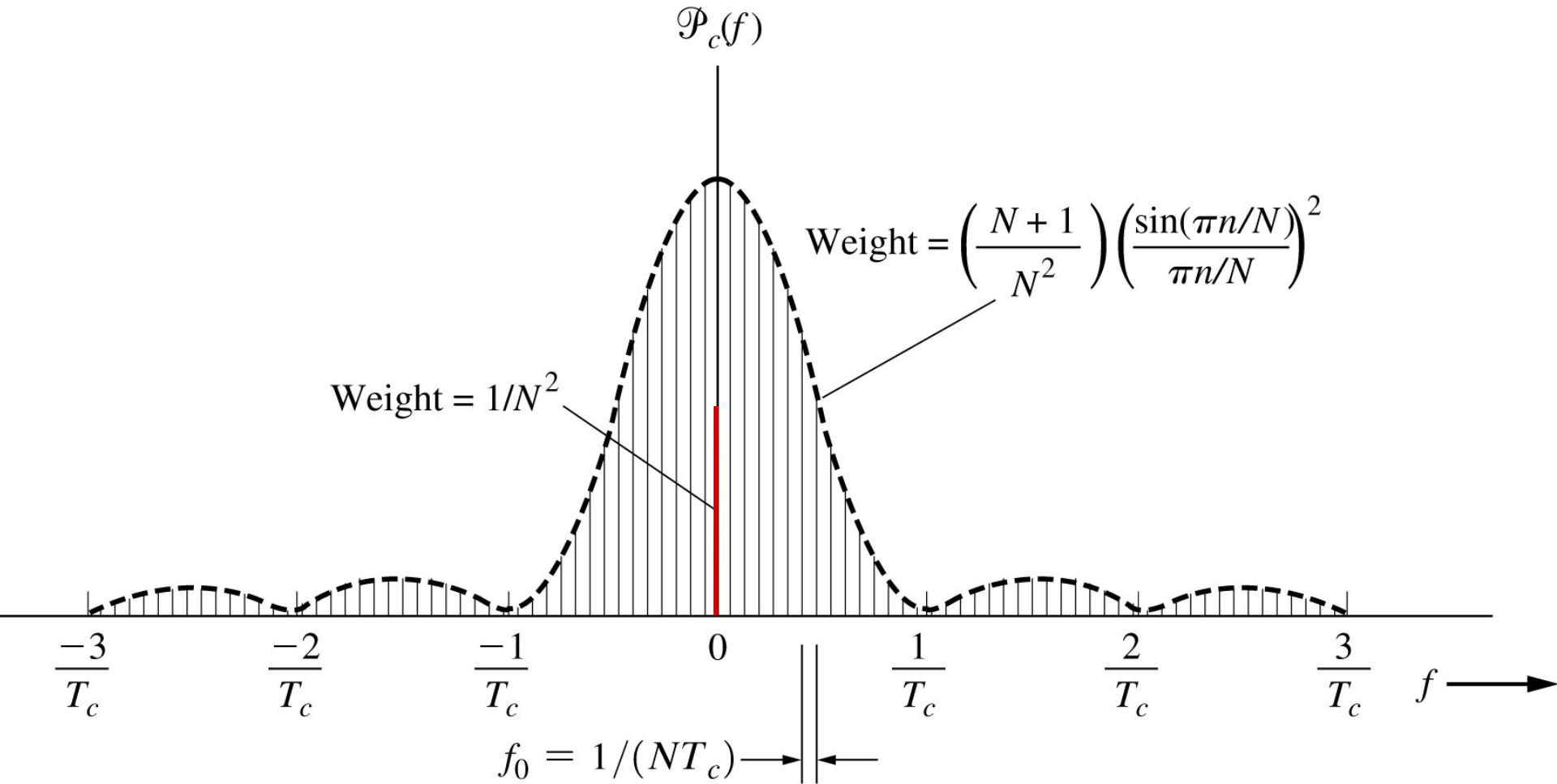
2^3 run of '1' & '0' of length $r-5$

2^{r-3} run of '1' & '0' of length 1

PN: Autocorrelation



PN: PSD



Questions ???

Thank You