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Experiment 6:

Modulation and Pulse Shaping

포항공과대학교 전자전기공학과
Communication and Intelligent Systems Lab. (CISL)

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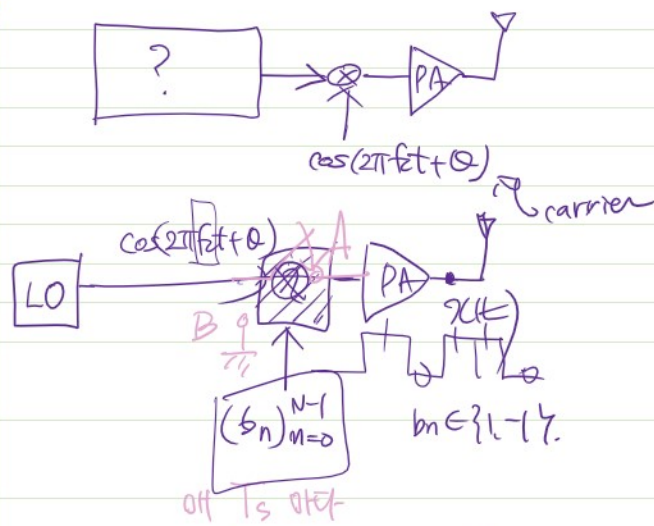
Outline

1. Modulation and Pulse Shaping
2. Today's Experiment
3. About Report

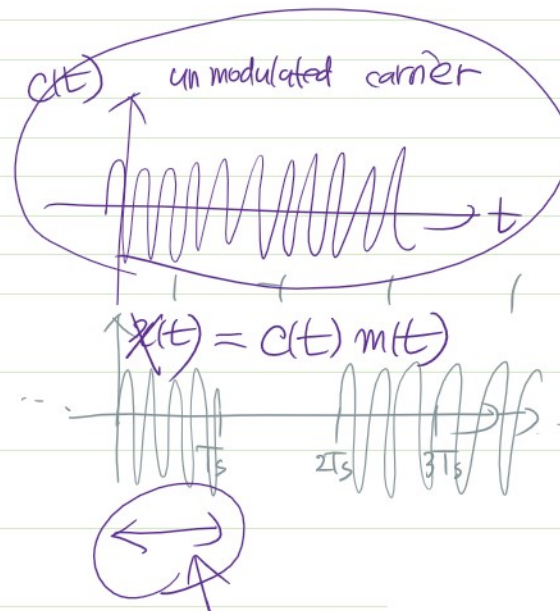
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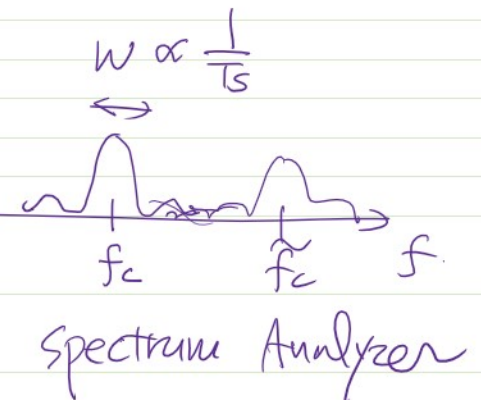
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OOK (On-Off Keying)



Spectrum mask



Spectrum Analyzer

출력 (un-VT keying)

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$$X(t) = c(t) m(t)$$

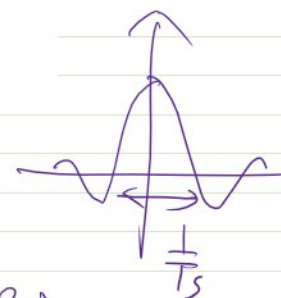
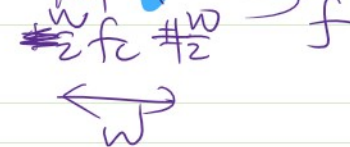
$$P_{xx}(f) \propto$$

$$\frac{1}{T_s} |P(f)|^2$$

$$P_{xx}(f) \propto$$

$$(|P(f-f_c)|^2 + |P(f+f_c)|^2) + a\delta(f-f_c) + a\delta(f+f_c)$$

(S)



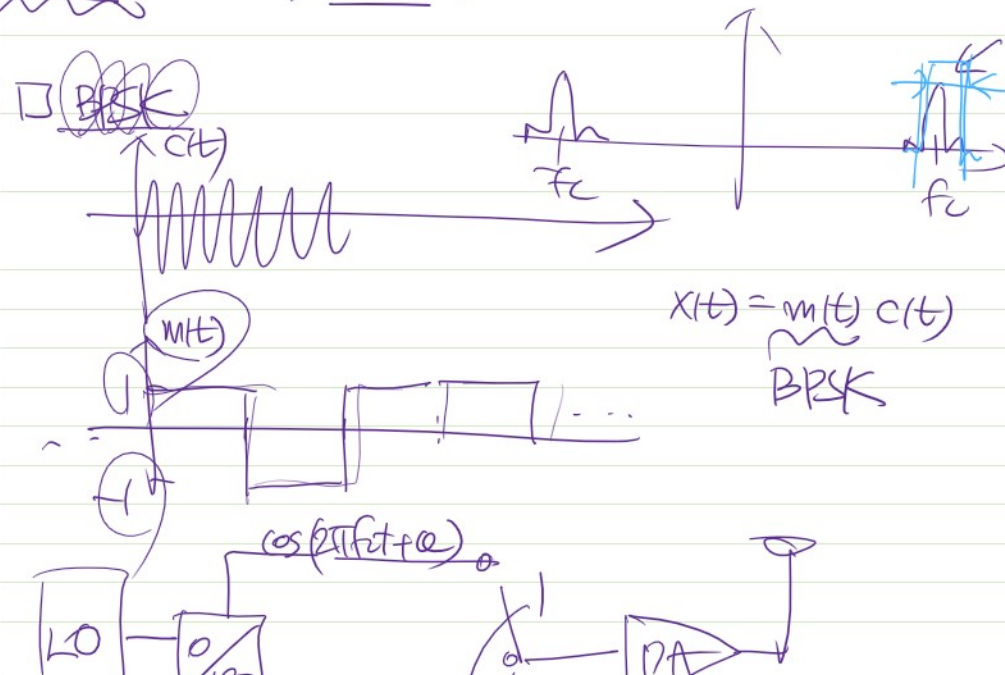
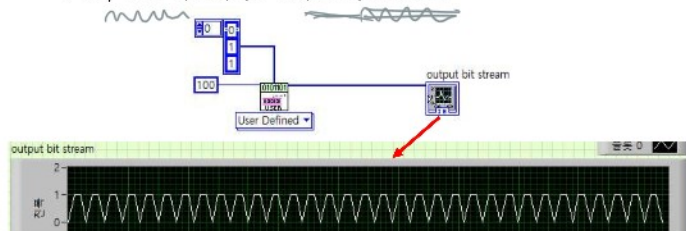
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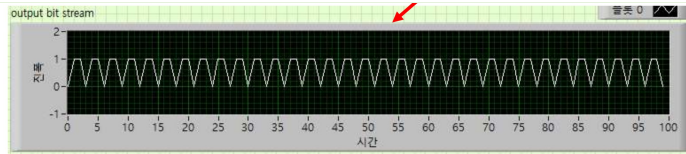
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Modulation and Pulse Shaping

- Bit array generation
 - 함수 팔레트 → RF communications → Modulation → Digital
 - MT generate bits (poly).vi
 - Mode 1 : User Defined
 - ex) "0 1 1"이 반복되는 길이 100의 bit stream





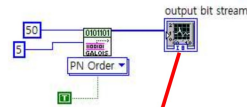
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Modulation and Pulse Shaping

- Bit array generation
 - Mode 2 : PN sequence
 - ex) 길이 50, order 5인 PN sequence



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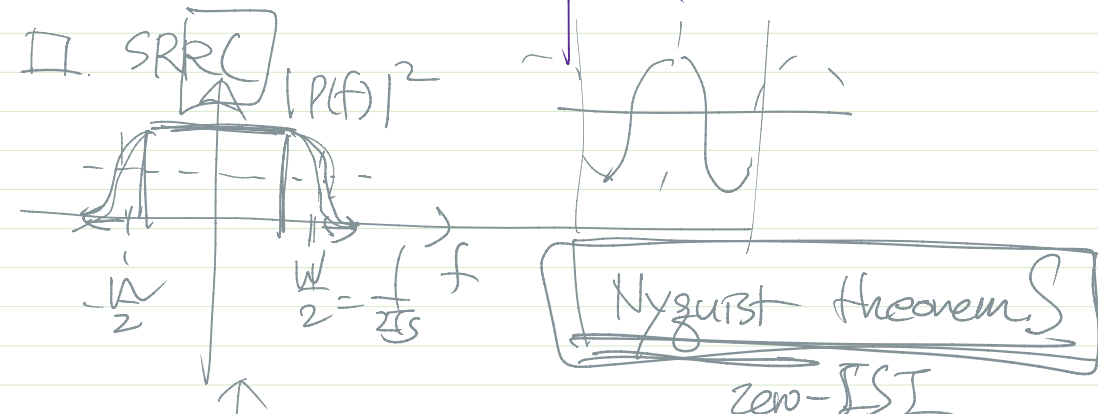
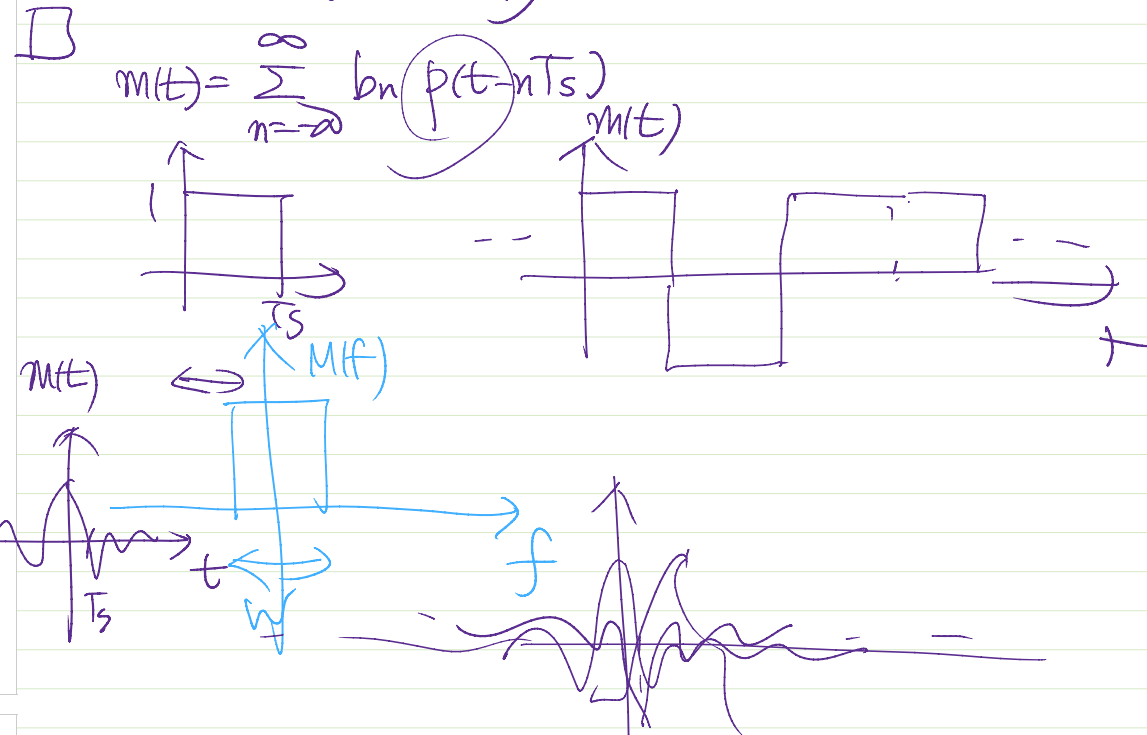
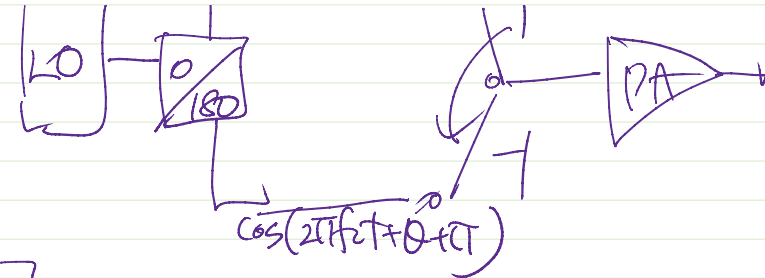
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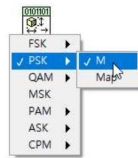
Modulation and Pulse Shaping

- Modulation
 - System parameter : modulation scheme 결정, 관련 parameter 출력
 - Modulation → Digital → Utilities → Sys params
 - Samples per symbol : symbol 하나당 sample 개수
 - M : M-PSK에서 M의 값

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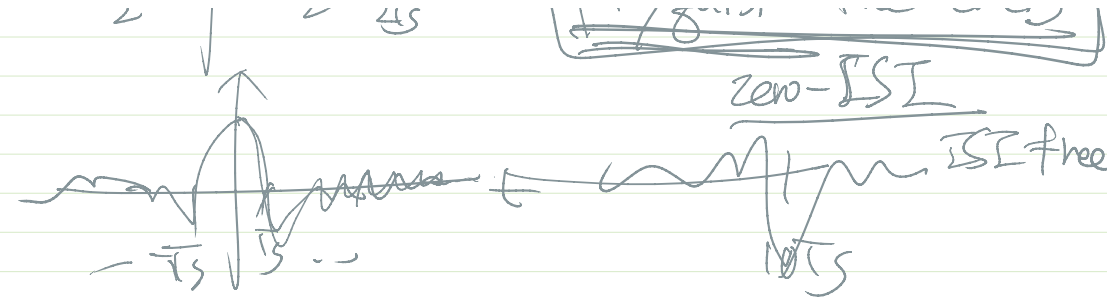
- M : M-PSK에서 M의 값



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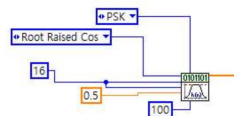
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Modulation and Pulse Shaping

- Modulation
 - Filter coefficients : pulse shaping에 사용할 filter 결정
 - Modulation → Digital → Utilities → Filter coefficients
 - 입력 : Samples per symbol, filter 종류, roll-off factor
 - 출력 : upsampling에 사용될 pulse shaping filter와 상응하는 matched filter



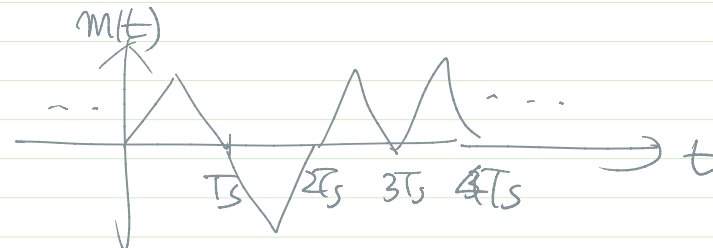
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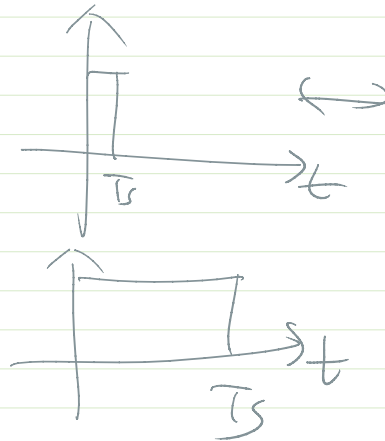
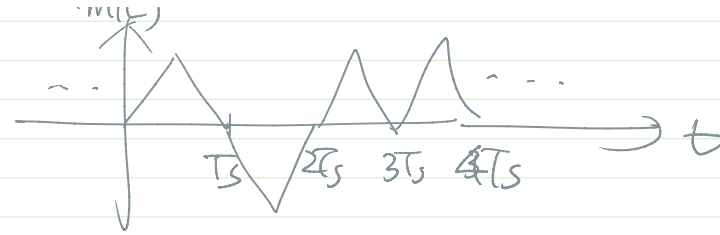
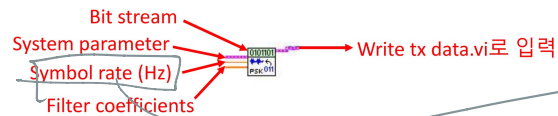
Modulation and Pulse Shaping

- Modulation
 - Modulation → Digital → Modulation
 - bit stream, filter coefficients, system parameter를 입력으로 받아



Modulation and Pulse Shaping

- Modulation
 - Modulation → Digital → Modulation
 - bit stream, filter coefficients, system parameter를 입력으로 받아 modulation 진행.
 - Symbol rate : 어떻게 계산해야 하는지 고민, 적절한 값을 입력.
 - 출력 : complex waveform “cluster”
 - 이 출력을 write tx data.vi에 입력하여 USRP로 전송.
 - 타입을 single channel -> Complex Double Cluster [CDB cluster] 로 선택.



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Today's Experiment

- Order 8인 m-sequence(PN sequence)를 generate하여
- BPSK로 modulation하여 전송하고,
- 이를 spectrum analyzer로 관찰하자.
- Filter : none
- Samples per symbol : 최소 10, 짝수로.
- Center frequency : 2.3765GHz

Outline

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About report

- Due: 2024. 10. 21 (월) 오후 4:59
- Must be included :
 - 전송 결과
 - 코드(block diagram), 프런트 패널, spectrum analyzer 결과
 - IQ rate, samples per symbol가 spectrum analyzer 결과에 미치는 영향
- jhchoi0226@postech.ac.kr 로 제출