

Experiment 9:

USRP Receiver (2)

포항공과대학교 전자전기공학과
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Outline

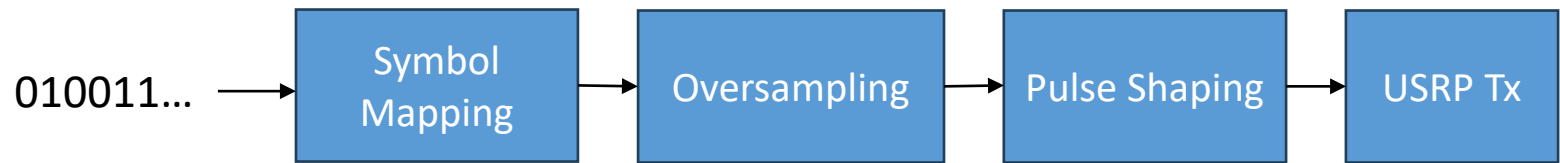
1. USRP Receiver (2)
2. Today's Experiment
3. About Report

Outline

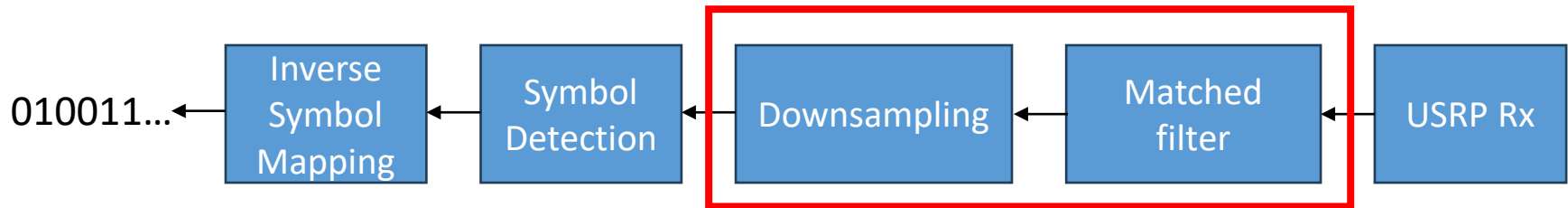
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USRP Receiver (2)

- Today We will do...



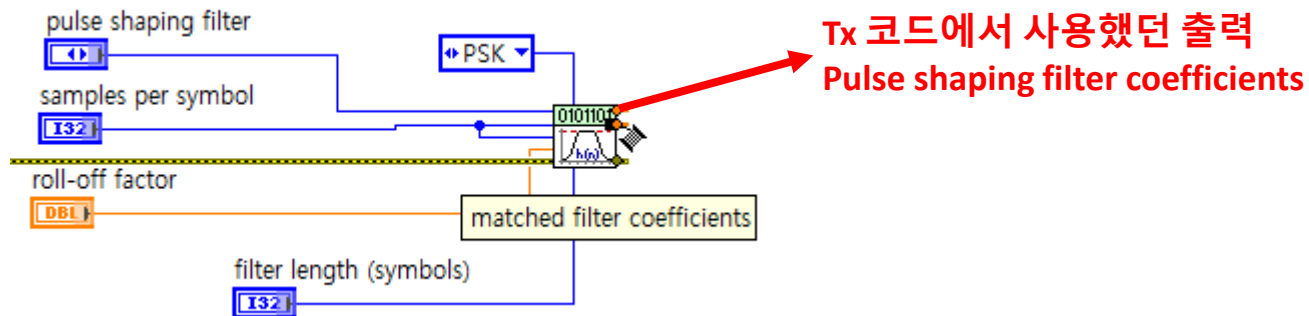
< Transmitter >



< Receiver >

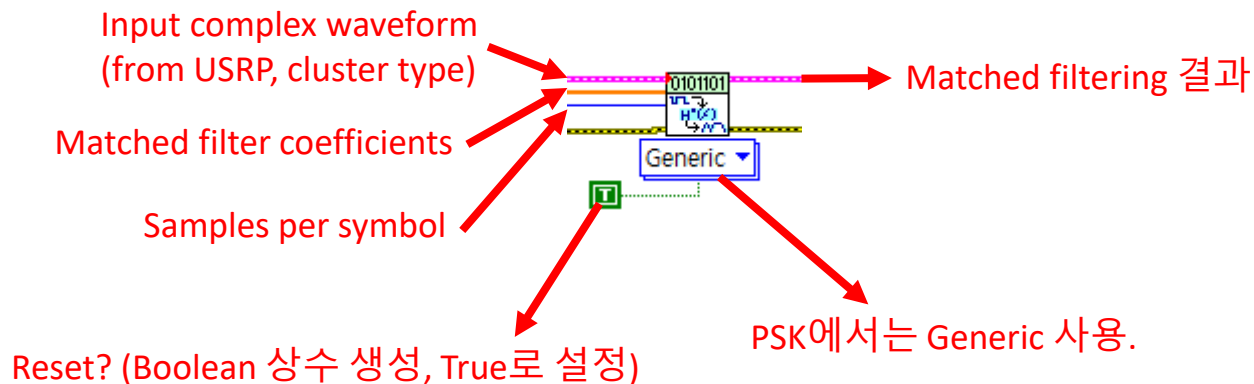
USRP Receiver (2)

- Matched filtering : MT Generate Filter Coefficients
 - Modulation → Digital → Utilities → Filter coefficients
 - Tx에서 pulse shaping 할 때 사용했던 vi와 동일.
 - 입력 : pulse shaping filter, samples per symbol, filter parameter, modulation type, filter length (11로 할 것)
 - 출력은 pulse shaping filter coefficients가 아니라 matched filter coefficients를 사용.



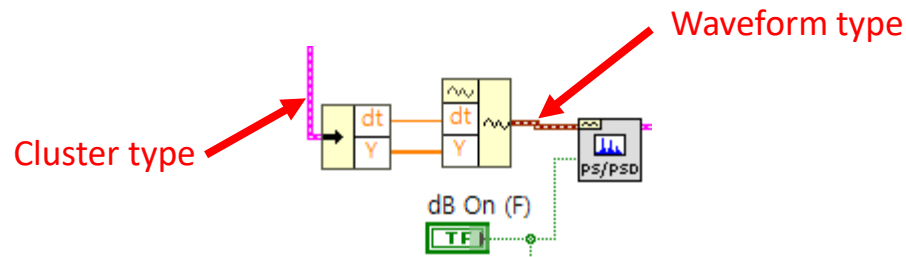
USRP Receiver (2)

- Matched filtering : convolution
 - Modulation → Digital → Utilities → Matched Filter
 - 입력 : input complex waveform (**cluster type**), matched filter coefficients, samples per symbol
 - 출력 : matched filter 결과 (convolution 결과)



USRP Receiver (2)

- Remind : cluster type의 수신 신호를 waveform type으로 변환
 - Cluster type 신호에서 dt, Y를 추출
 - 프로그래밍 → 클러스터 → 이름으로 풀기
 - 이를 “waveform 만들기”의 dt, Y에 입력
 - 프로그래밍 → 웨이브폼 → 웨이브폼 만들기
 - Power spectrum을 보려면 waveform type으로 변환하여 입력해야 함.

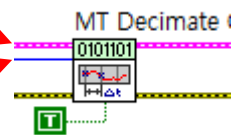


USRP Receiver (2)

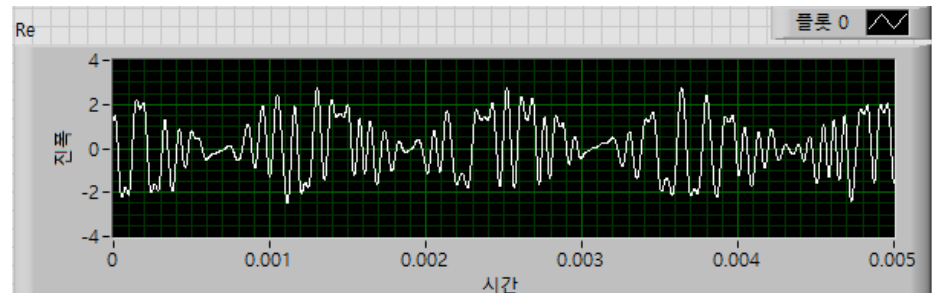
- Decimation : downsampling
 - Tx에서 M배 oversampling한 신호를 전송하면
 - Rx에서는 M배 downsampling하여 symbol detection 수행.
 - Modulation → Digital → Utilities → Decimate Cmplx Wfm

Input complex waveform
(after matched filtering)

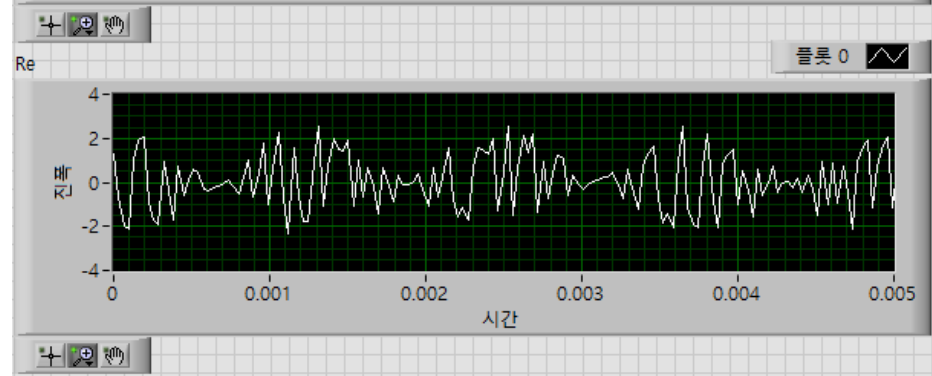
Decimation factor
(= Tx oversampling factor)



Before

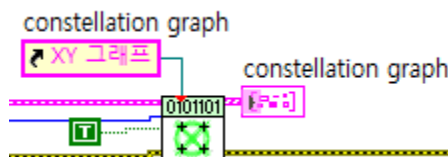


After



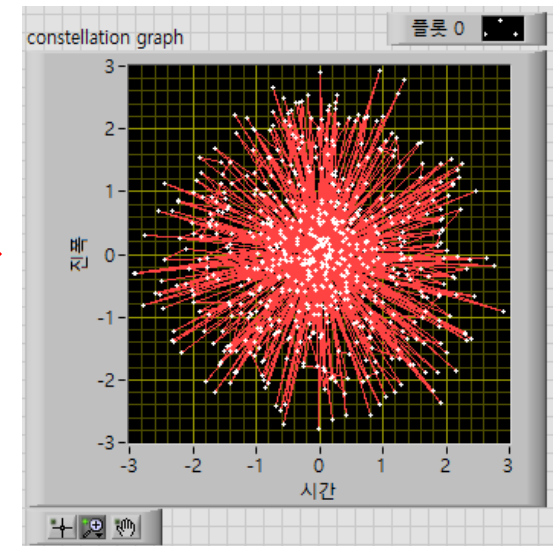
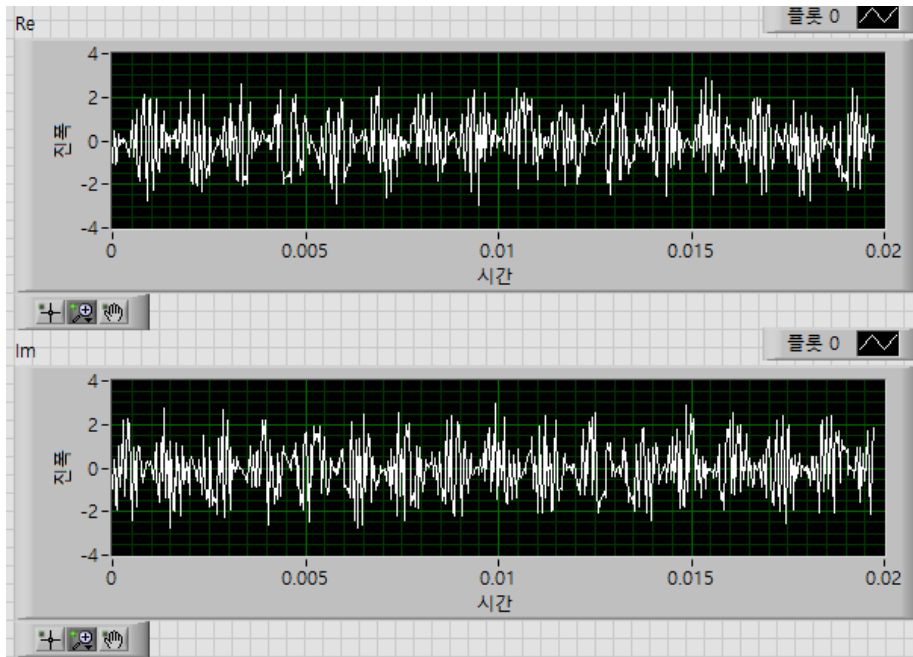
USRP Receiver (2)

- Constellation : symbol을 IQ plain에 plot
 - Modulation → Digital → Visualization → Constellation
 - 입력 : Waveform, samples per symbol, constellation reference
 - Reference : 우클릭 → 어플리케이션 컨트롤 팔레트 → VI 서버 참조
 - 출력 인디케이터 생성, 그래프 대체 후
참조 우클릭 → 링크 → 인디케이터 이름 선택
 - Samples per symbol : 1로 설정
 - 출력 : constellation graph
 - Front panel에서 우클릭 후 “XY 그래프”로 대체



USRP Receiver (2)

- Constellation : symbol을 IQ plane에 plot



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Today's Experiment

- USRP 신호 수신 (type : single channel → complex double waveform)
 - 송신 신호 정보
 - IQ rate : 500,000 samples/s (=500 kS/s)
 - Filter : Root Raised Cosine
 - Roll-off factor : 0.35
 - Oversampling factor : 16
 - Center frequency : 2.3765 GHz
 - Matched filtering, downsampling 과정을 포함한 USRP Rx code 작성
 - Fetch Rx Data에서 number of samples = 10,000
 - 각 단계별 수행 결과를 그래프로 출력 (time domain은 Re, Im 값을 각각 출력)
 - Matched filtering : 수행 전/후의 signal을 time domain⁽¹⁾, frequency domain⁽²⁾에서 출력
 - Downsampling : 수행 전/후의 signal을 time domain⁽³⁾에서 출력
 - 수행 전/후의 차이가 보이도록 충분히 확대해서 capture
 - Downsampling 후의 signal은 constellation diagram⁽⁴⁾도 출력
 - 결과 분석
 - Downsampling 결과를 이용하여 symbol detection이 제대로 이루어질 수 있는가?
 - 없다면, 그 이유가 무엇일지 discussion

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About Report

- Due: 2024.11.18. (월) 오후 04:59
- Must be included :
 - USRP 신호 수신 및 각 단계별 수행 결과
 - 코드(block diagram)⁽¹⁾, 프런트 패널⁽²⁾
 - Time domain
 - Matched filtering 수행 전⁽³⁾
 - Matched filtering 수행 후⁽⁴⁾ (= Downsampling 수행 전)
 - Downsampling 수행 후⁽⁵⁾
 - Frequency domain : Matched filtering 수행 전⁽⁶⁾/후⁽⁷⁾
 - Downsampling 수행 후의 signal의 constellation diagram⁽⁸⁾
 - 결과 분석
- jhchoi0226@postech.ac.kr 로 제출