



# Adaptive Roll-off Factor Utilization for FMT-based FBMC Burst Structures

***SDR FORUM-2013***

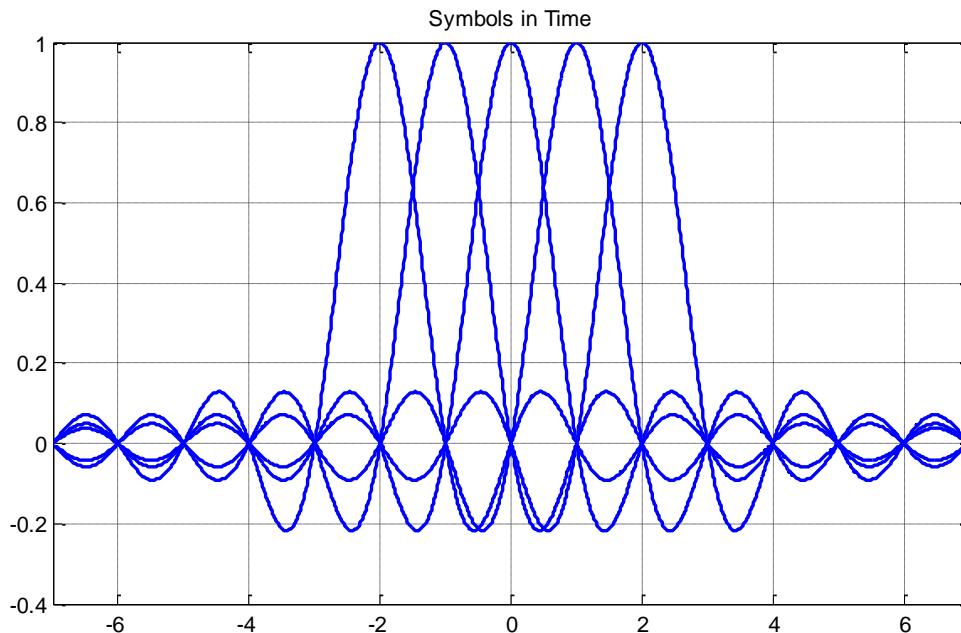
*Z.Esad Ankarali, Alphan Şahin, Huseyin Arslan*



# Adaptive Roll-off Factor Utilization for FMT-based FBMC Burst Structures



## Raised Cosine (RC) filters in time



Orthogonal to each other

Sidelobe problem

**Problem:**  
***Channel dispersions ?***

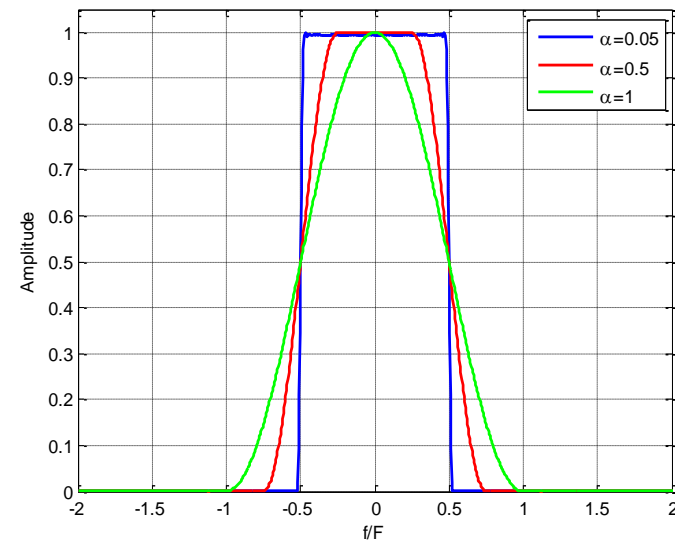
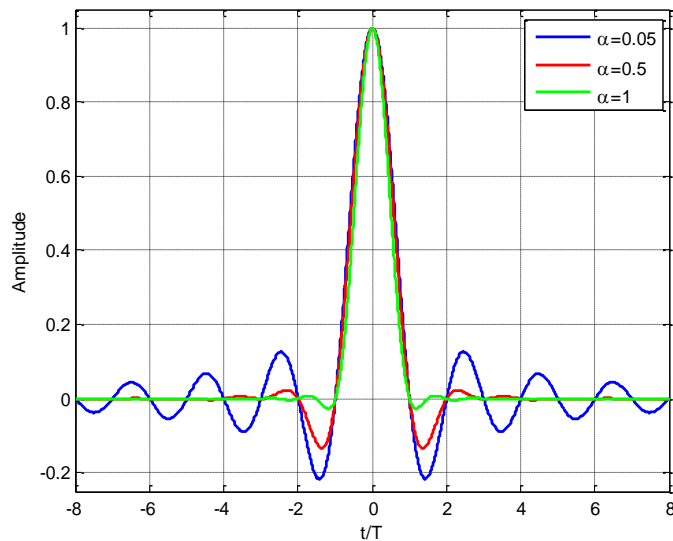
**Solution:**  
***Roll off factor( $\alpha$ )***



# Adaptive Roll-off Factor Utilization for FMT-based FBMC Burst Structures



## Effect of Roll off on filter's time and frequency characteristic



Conventional Design



Frequency Spacing  
Roll off factor  
*for the worst case*

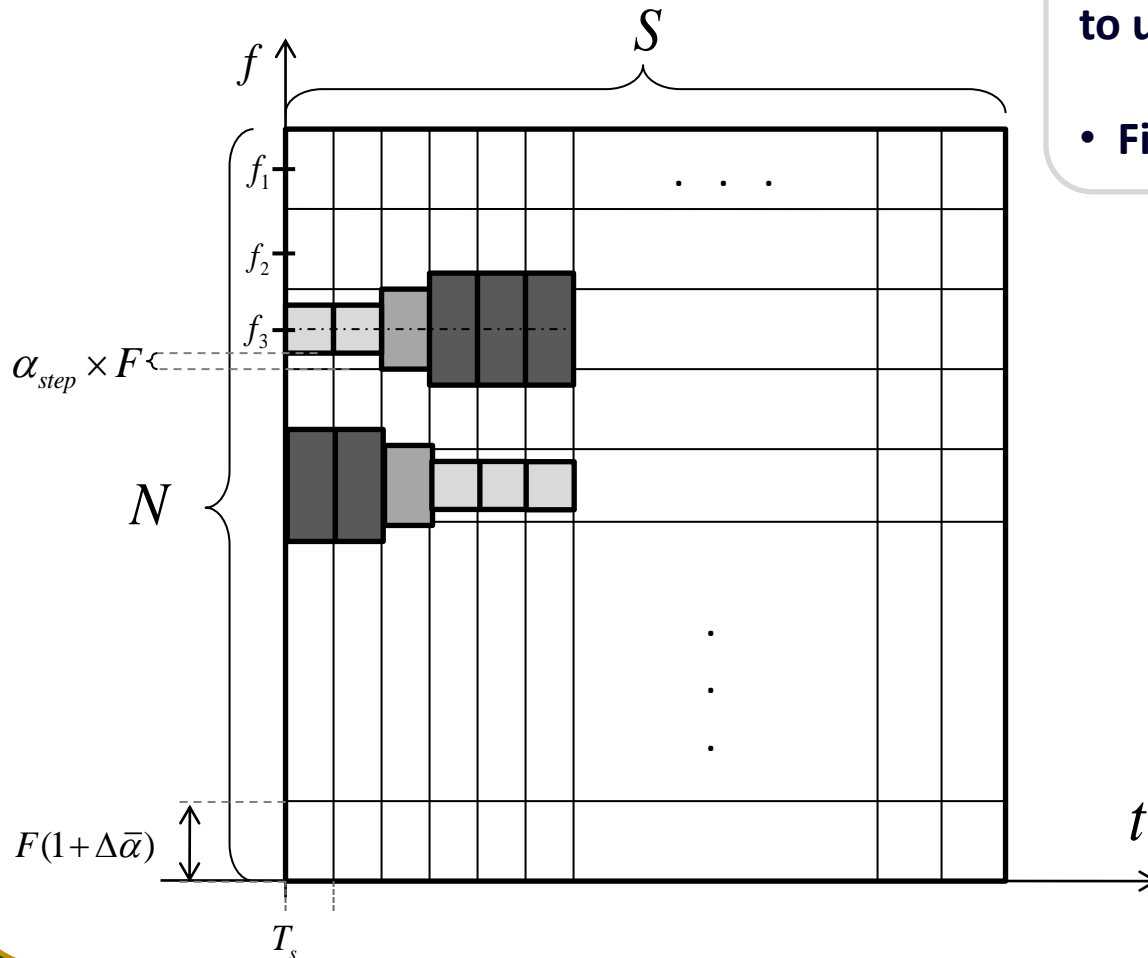
**Overdesign!**



# Adaptive Roll-off Factor Utilization for FMT-based FBMC Burst Structures



## Proposed Burst Structure



- **Adaptively changing  $\alpha$ , according to users' own channel**
- **Fixed subcarrier spacing**

$T_s$ : Symbol Time

$f_n$ : central frequency of  $n$ th subchannel

$\Delta\bar{\alpha}$ : Average roll off

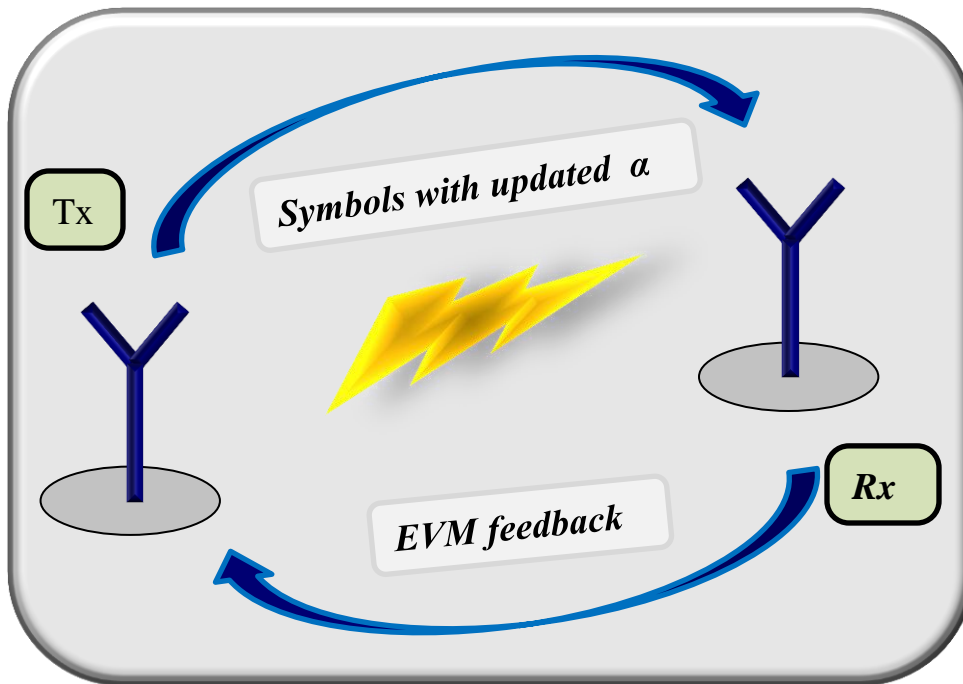
$$F = 1/T_s$$



## Adaptive Roll-off Factor Utilization for FMT-based FBMC Burst Structures



$\alpha$  update with EVM feedback



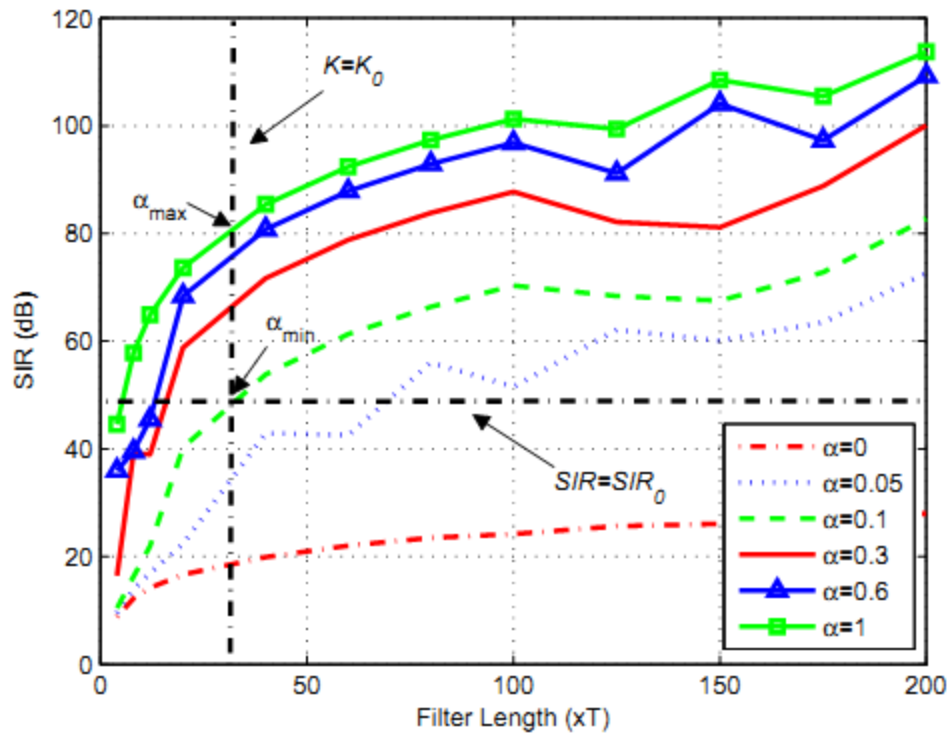
### Burst design parameters

- Max. and min.  $\alpha$
- $\alpha$  step
- Average  $\alpha$



## Adaptive Roll-off Factor Utilization for FMT-based FBMC Burst Structures

### Up and down limits of $\alpha$



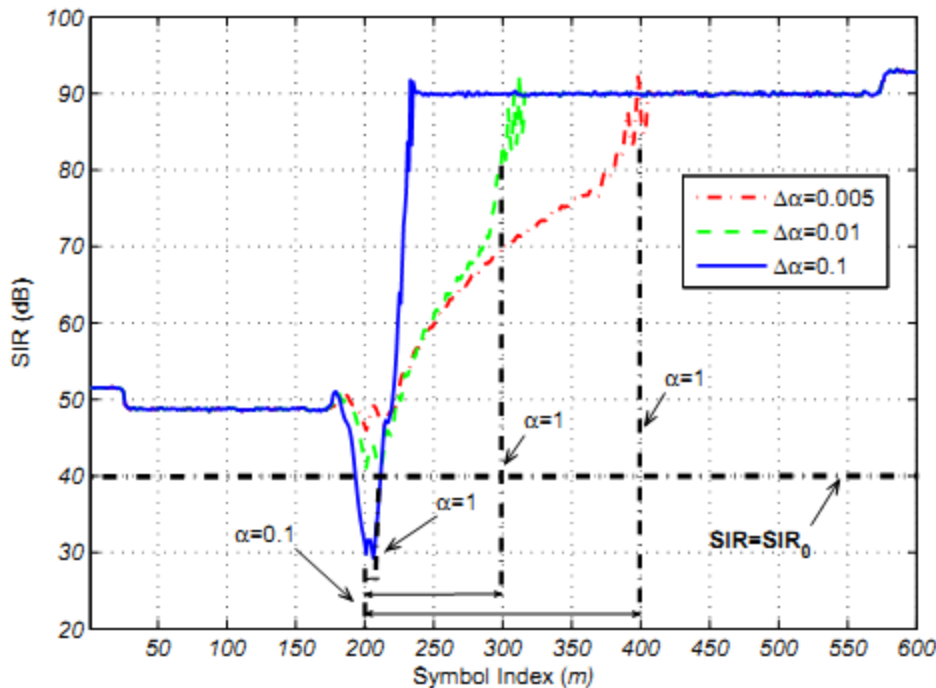
- Min.  $\alpha$  is determined according to minimum desired Signal to Interference Ratio (SIR)
- Filter length should be considered as well



## Adaptive Roll-off Factor Utilization for FMT-based FBMC Burst Structures



$\alpha$  step



*Orthogonality loss should be considered due to the  $\alpha$  change*

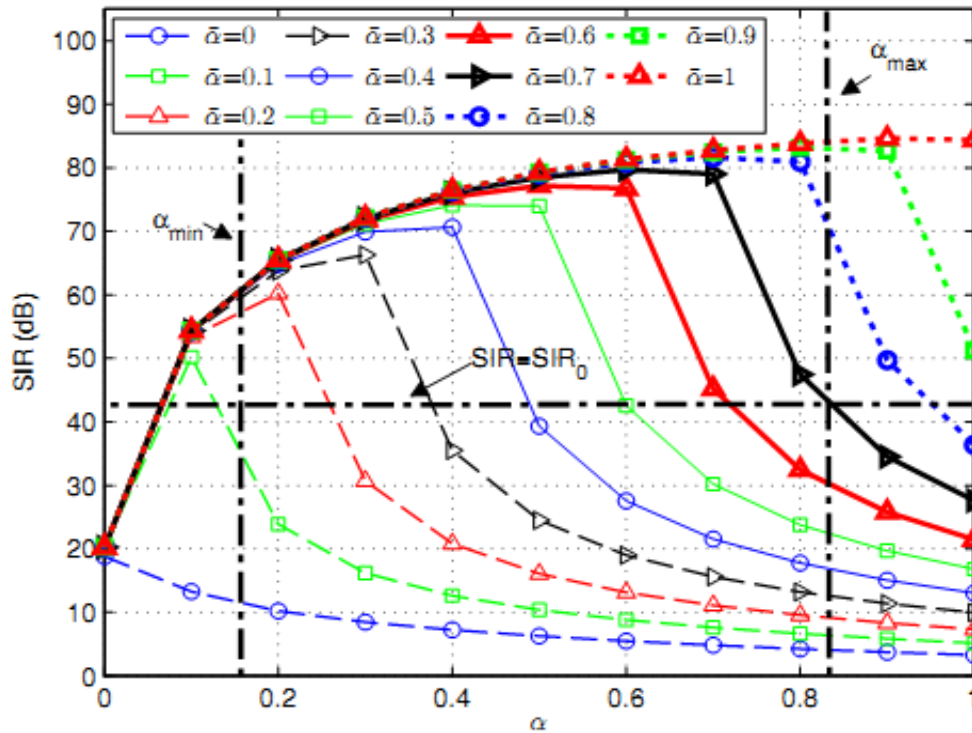
- Larger step size: More error, quick compensation
- Smaller step size: Less error, slow compensation



# Adaptive Roll-off Factor Utilization for FMT-based FBMC Burst Structures



Average  $\alpha(\bar{\alpha})$



By considering  $\alpha$  distribution and minimum desired SIR, minimum required average alpha which corresponds to subcarrier spacing, can be determined.

$$\bar{\alpha}_{\min} = \arg \min_{\bar{\alpha}} \left( \left| \overline{SIR}(\bar{\alpha}) - SIR_0 \right| \right)$$

$\overline{SIR}(\bar{\alpha})$  : Expected SIR for a given  $\bar{\alpha}$

$SIR_0$  : Min. Desired SIR





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### Results

$SIR_0$ (Theoretical)	$\alpha_{min}$	$\bar{\alpha}$	SIR (Simulation)
20 dB	0.05	0.35	23.4 dB
30 dB	0.05	0.55	39.8 dB
50 dB	0.2	0.75	57.4 dB

$$(\alpha_{max} = 1, \Delta\alpha = 0.01)$$

### Future Topics

*User scheduling and Implementation*



## Adaptive Roll-off Factor Utilization for FMT-based FBMC Burst Structures



# Thank you