การประยุกต์รหัสเทอร์โบและการปรับแต่งสัญญาณล่วงหน้าสำหรับการสื่อสารแบบไร้สายกับเทคนิคไดเวอร์ซิตี้

(Turbo codes and *Pre*-Equalization for Wireless communications with Diversity Techniques)

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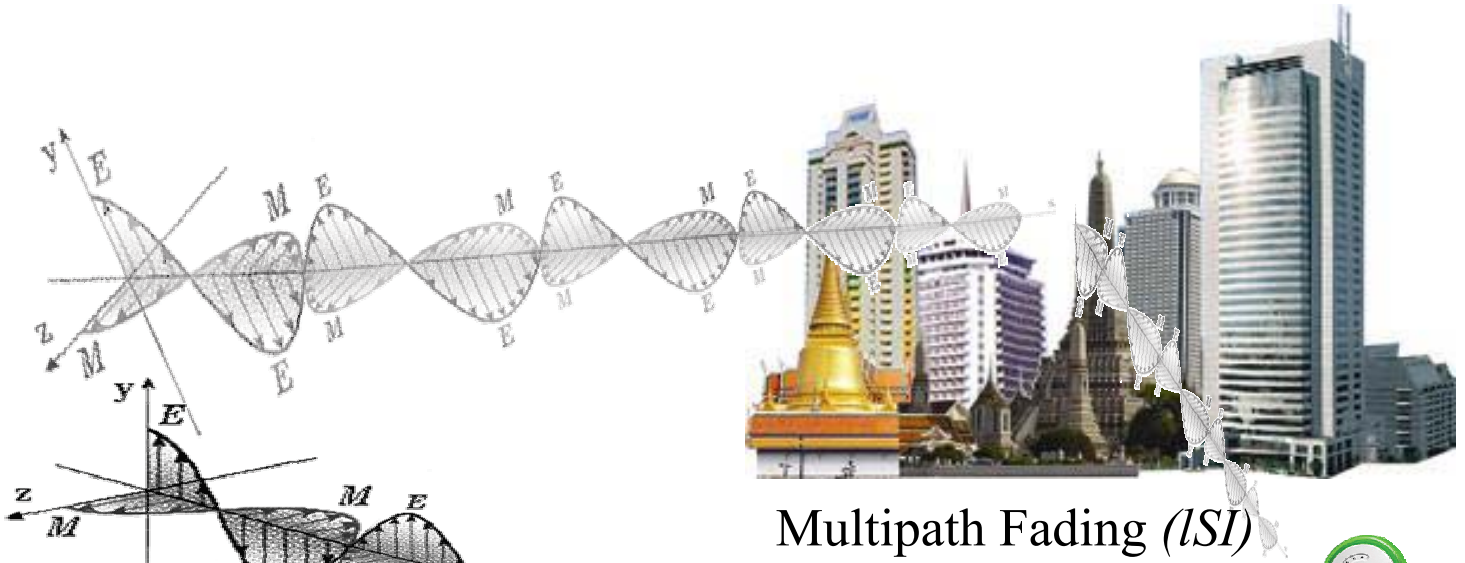
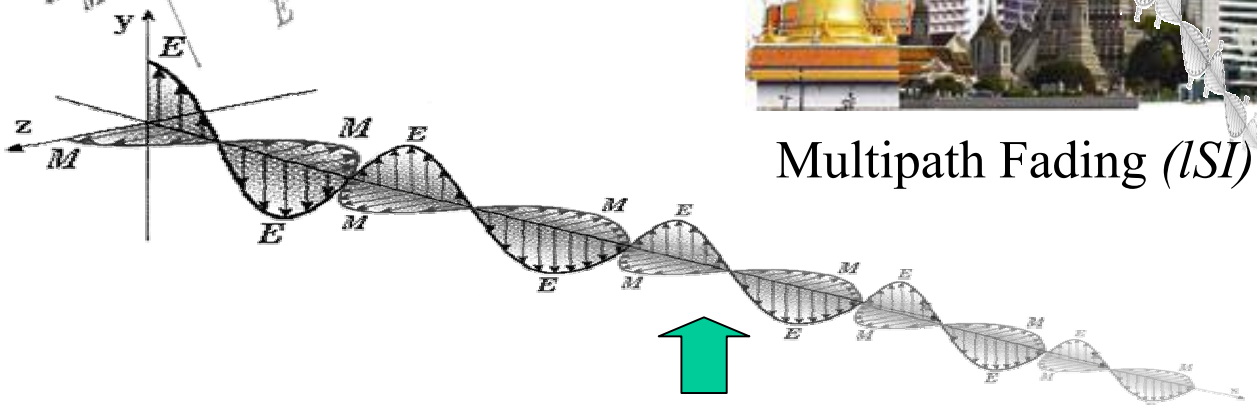
Topics

- Applications of Turbo codes and phase precoding
  - *Problems of noise and ISI*
  - *The proposed wireless transmission model*
  - *Applications of spiral curve and dimenson partitioning*
- *Mixed* Phase-Precoding
  - *Motivation*
  - *Principle and its low complicated detection*
- Future work
  - *Application of Turbo codes and phase precoding on Multiple-Input Multiple-Output (MIMO) communications.*

Noise and ISI Problems



Multipath Fading *(lSI)*



Transmitted signal

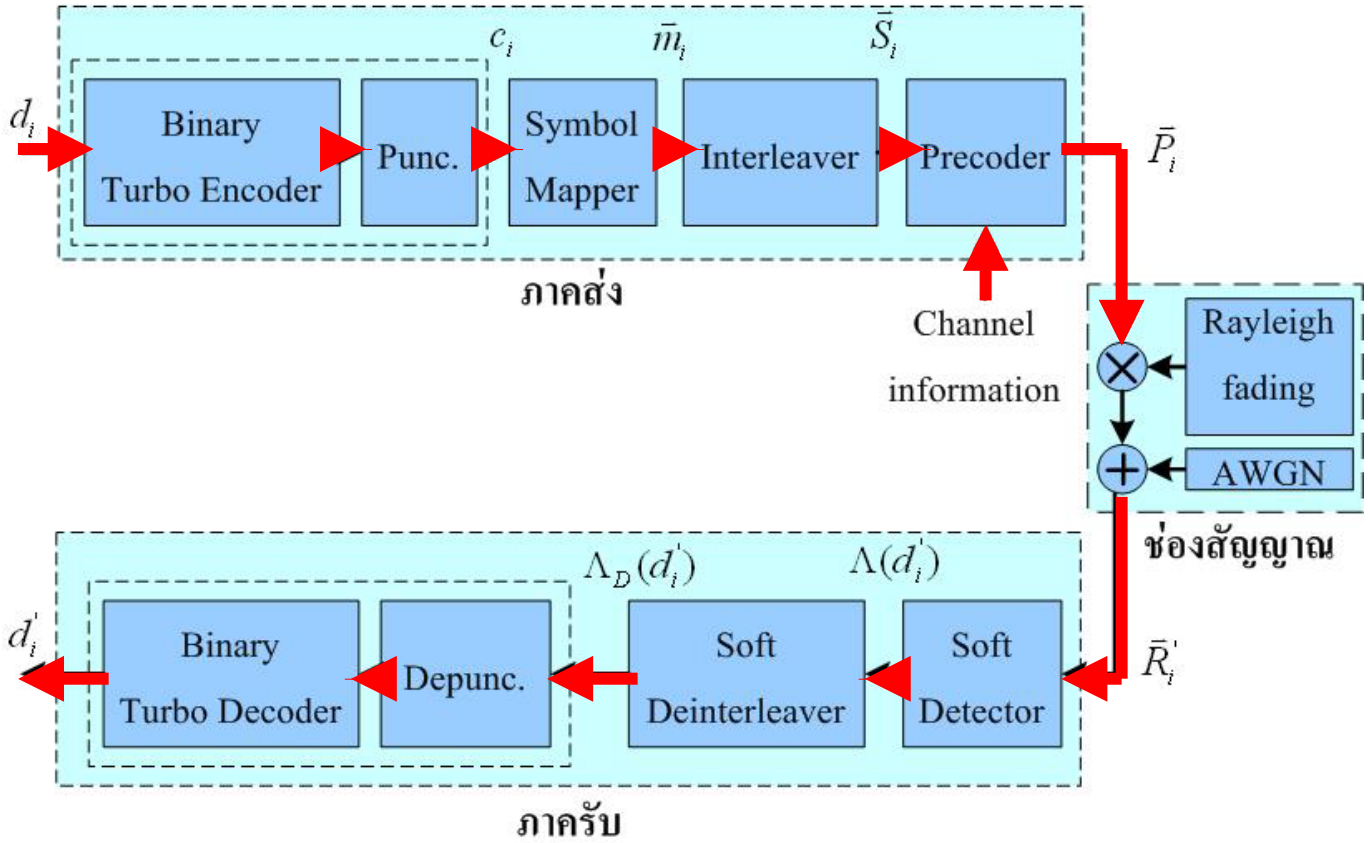
Noise

&

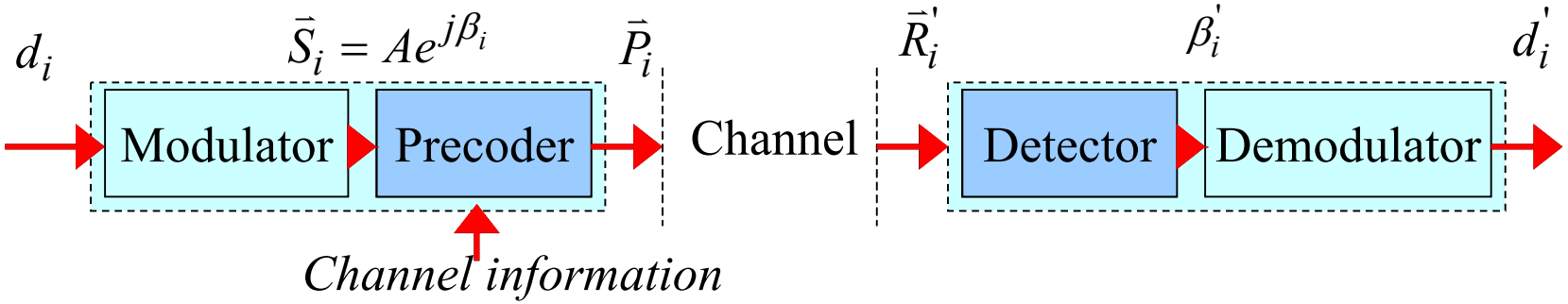
Fading

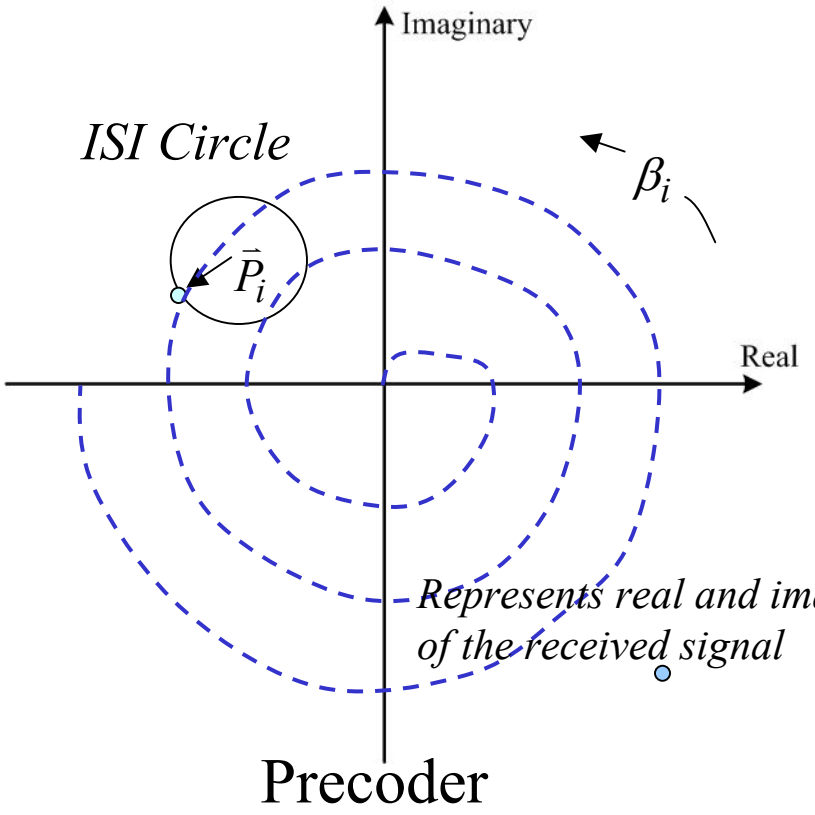
Received signal

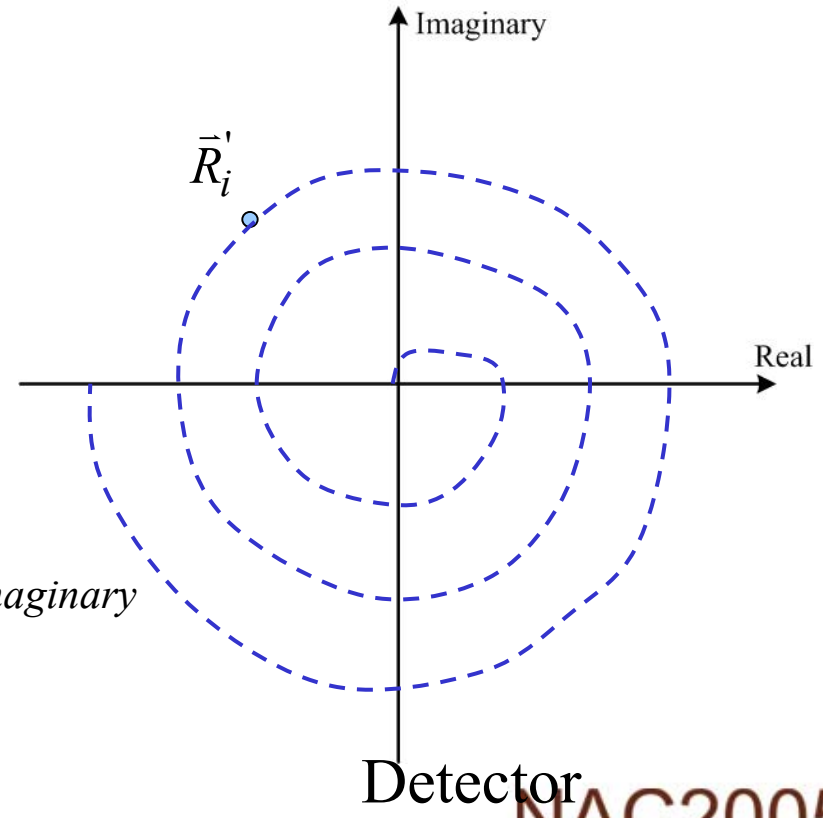
Proposed wireless transmission model



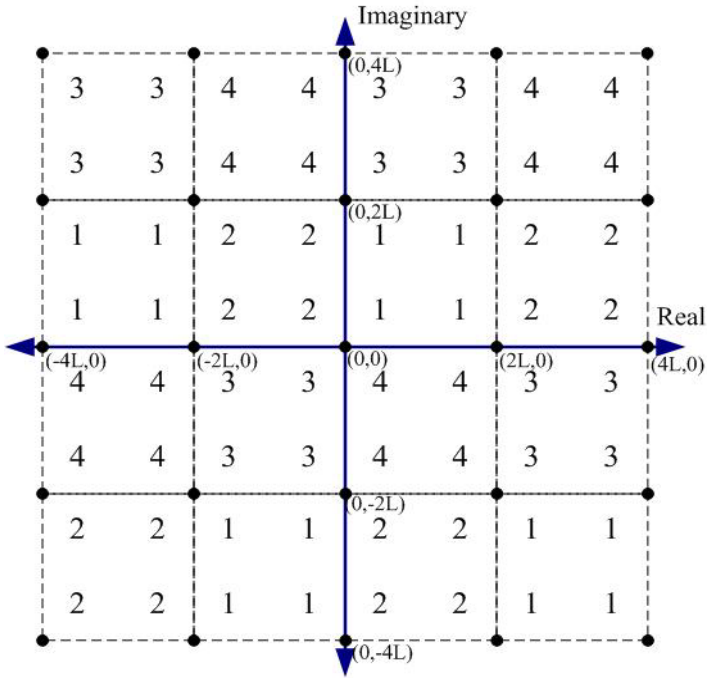
Spiral curve phase precoding







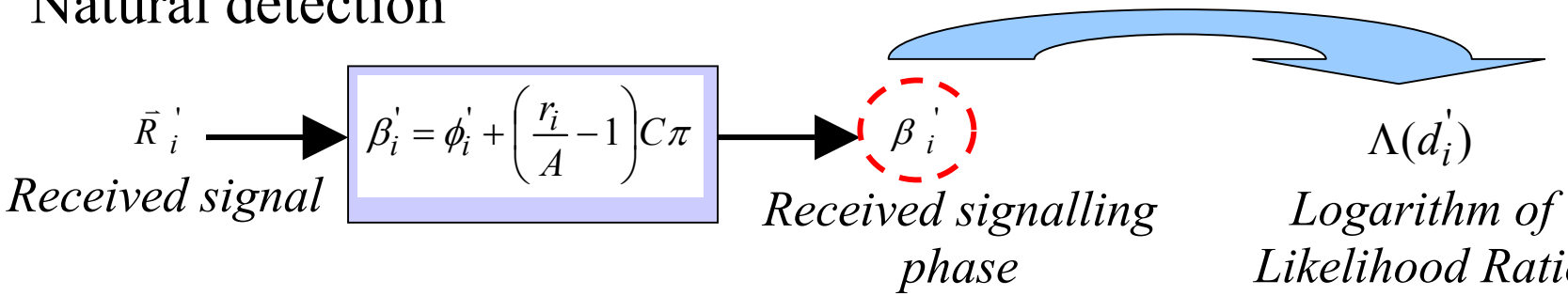
Dimension Partitioning



Dimension Partitioning

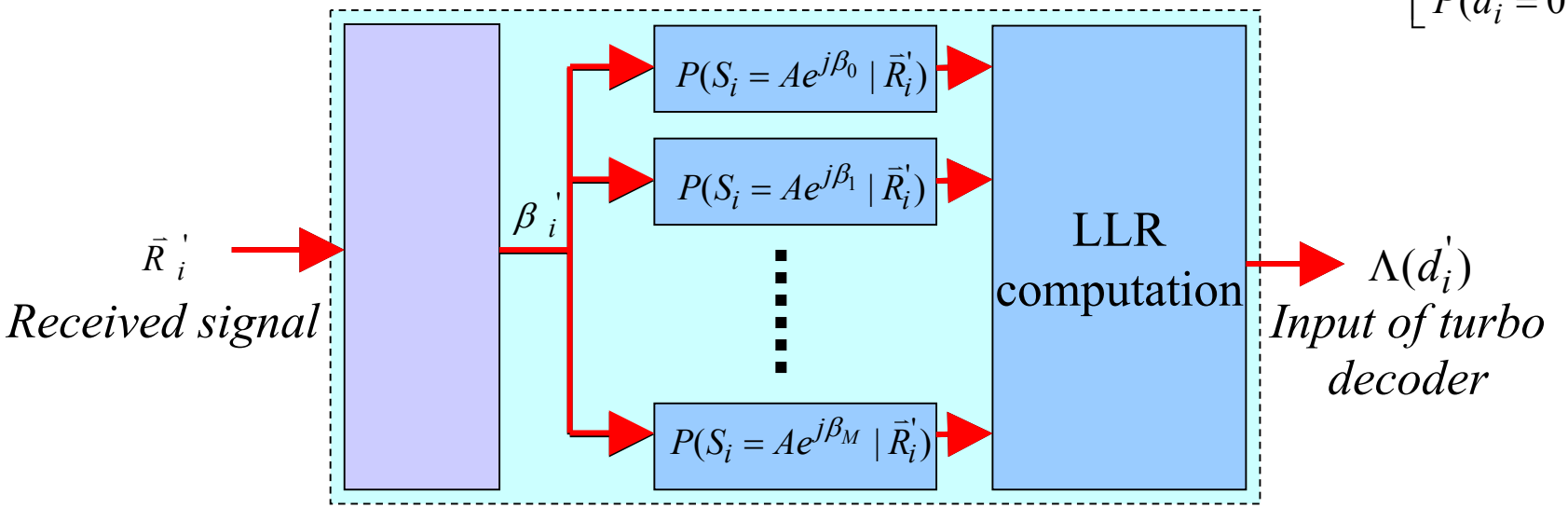
Detector modification of Spiral curve

- Natural detection



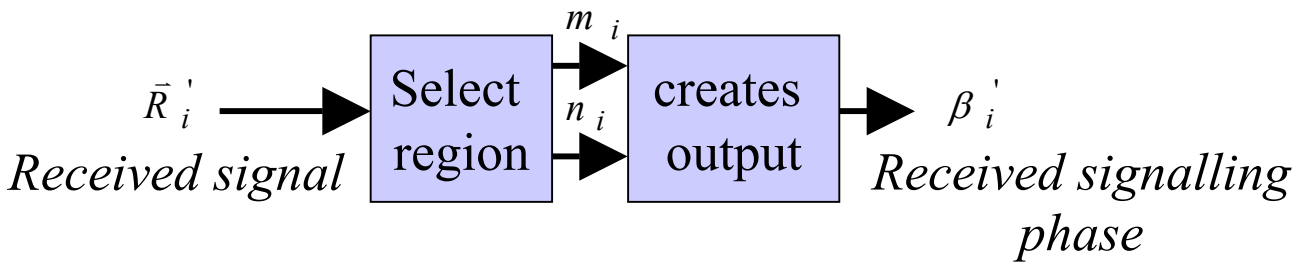
- Soft-output LLR Detection

$$\Lambda(d_i') = \log\left[\frac{P(d_i = 1 \mid \vec{R}_i')}{P(d_i = 0 \mid \vec{R}_i')}\right]$$

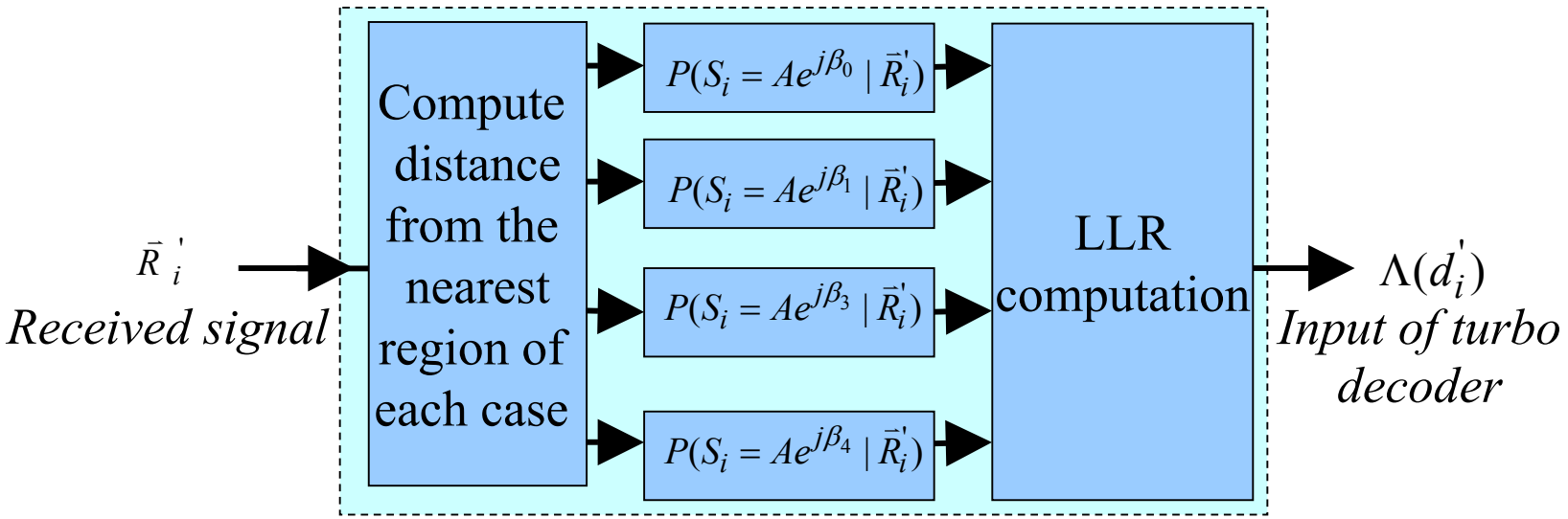


Detector modification of Dimension partitioning

- Natural detection

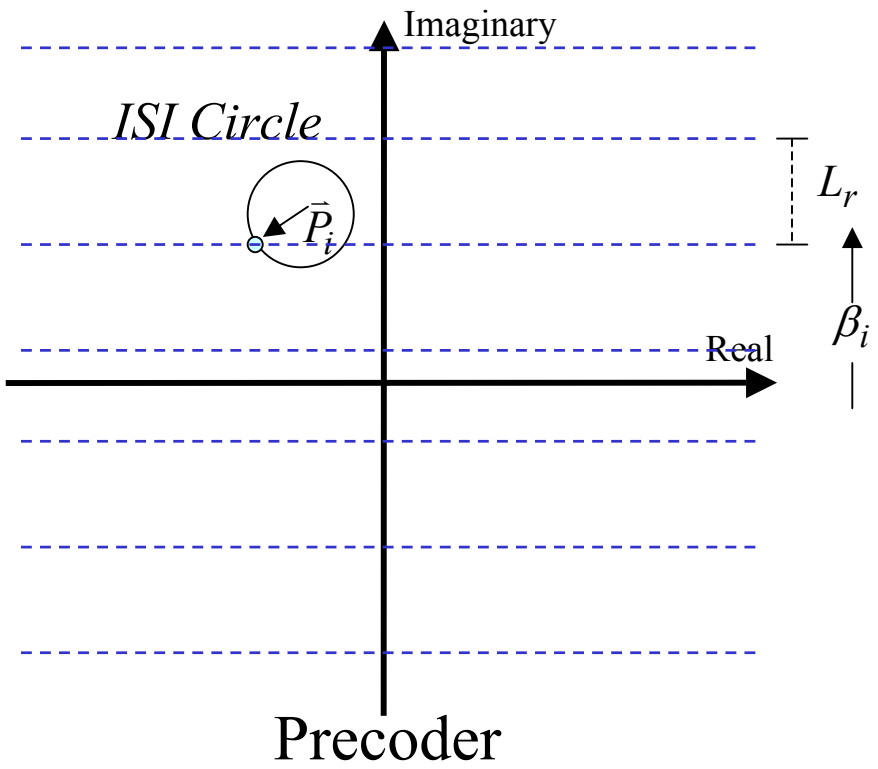


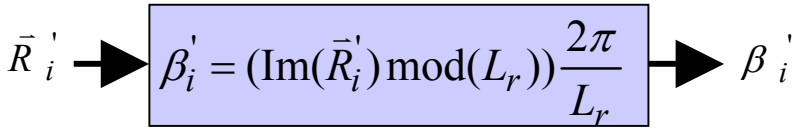
- Soft-output LLR Detection



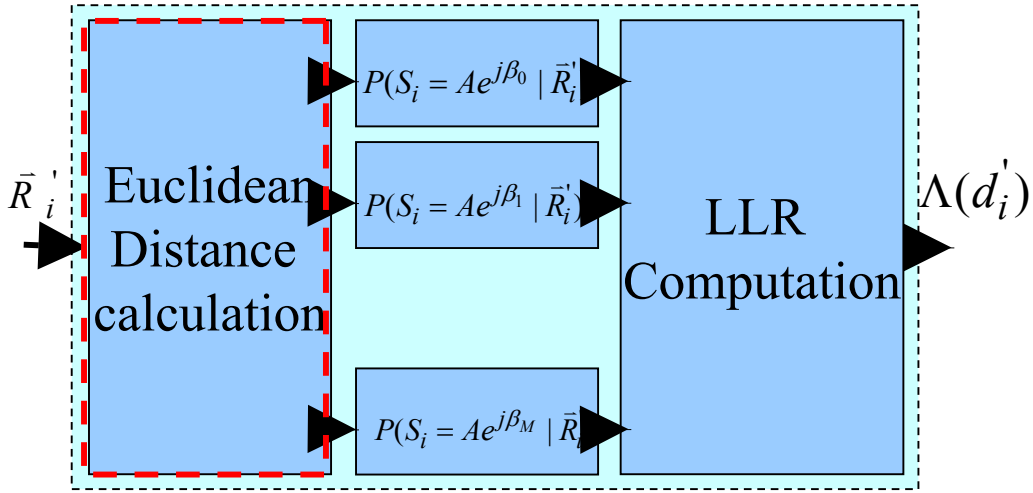
Mixed-Phase Precoding

- Modified from spiral curve to has a better gain
- Directly designed for applications with turbo codes



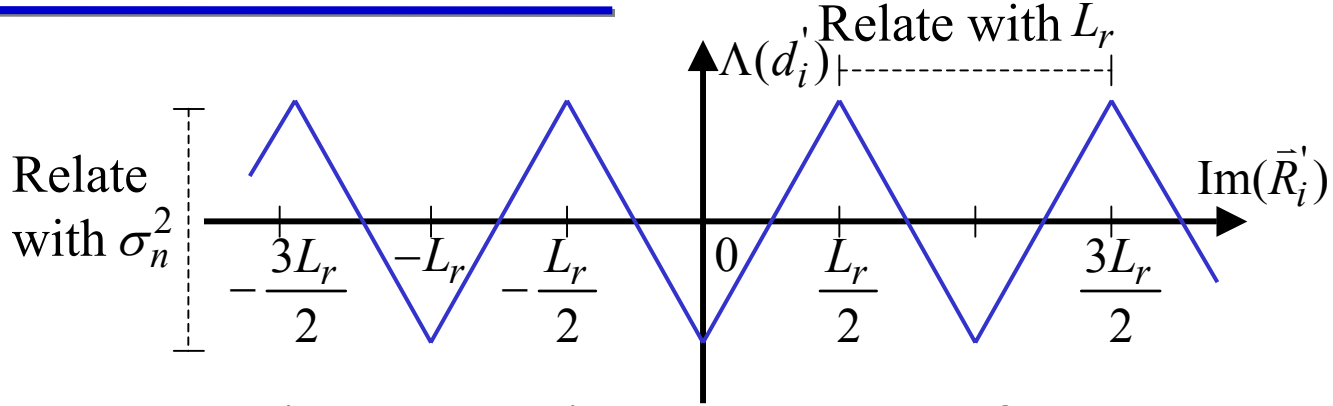


Phase Detector



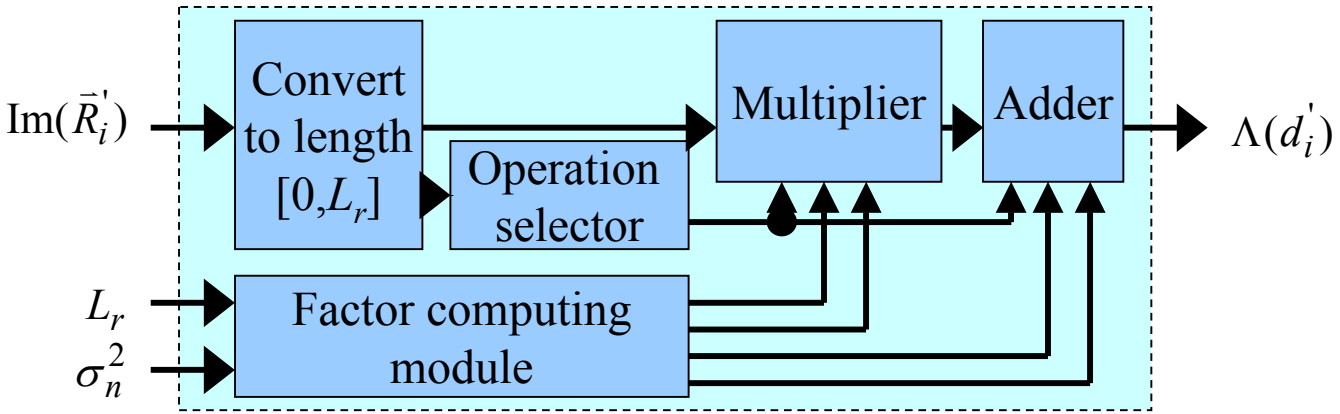
LLR Computing

Low complicated Detection (under evaluation)



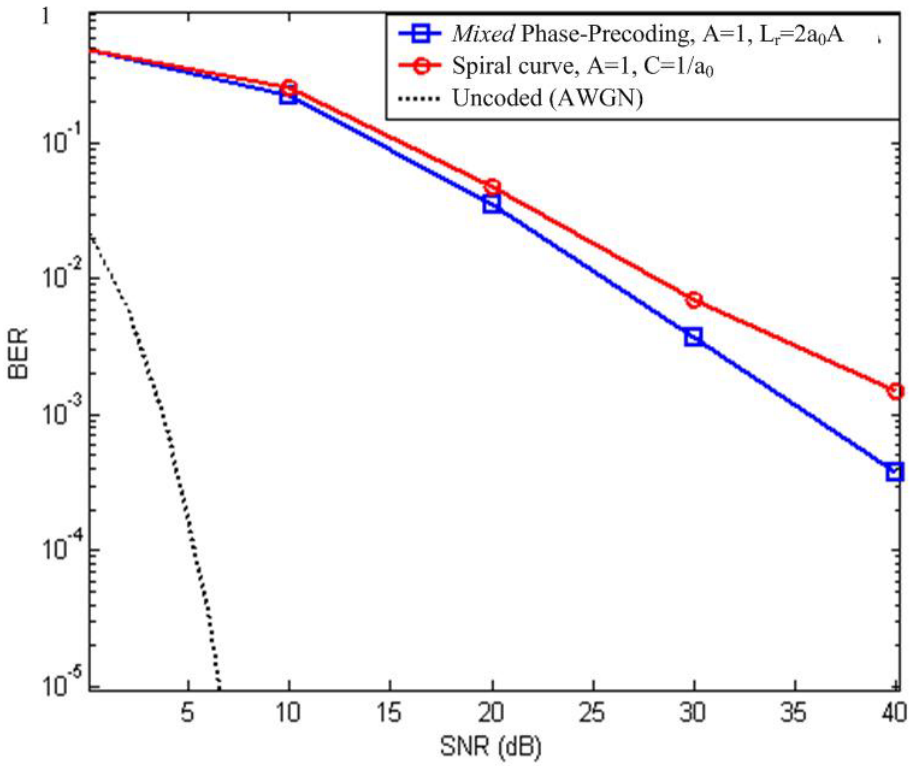
Relation between input and output of the detector

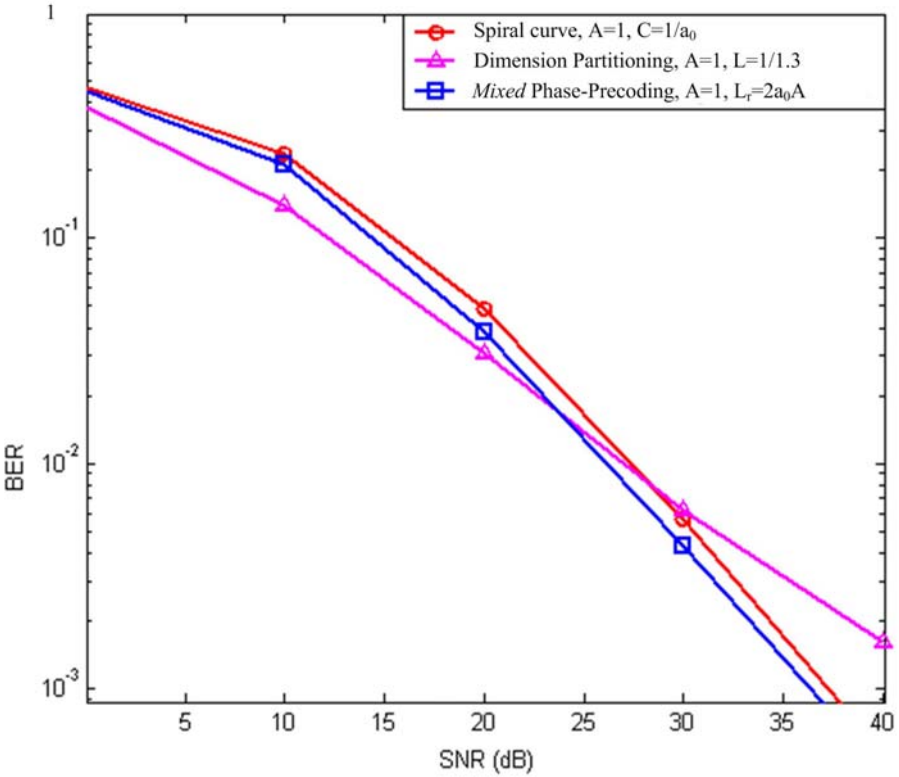
$$\Lambda(d_i') = \begin{cases} \frac{1}{2\sigma_n^2}[L_r \,\mathrm{Im}(\vec{R}_i') - \frac{L_r^2}{4}] & ; L_r/2 > \mathrm{mod}(\mathrm{Im}(\vec{R}_i')) \\ \frac{1}{2\sigma_n^2}[\frac{3L_r^2}{4} - L_r \,\mathrm{Im}(\vec{R}_i')] & ; L_r/2 \le \mathrm{mod}(\mathrm{Im}(\vec{R}_i')) \le L_r \end{cases}$$



Detector (BPSK)

Simulation results





- BPSK
- QPSK with Gray code mapping

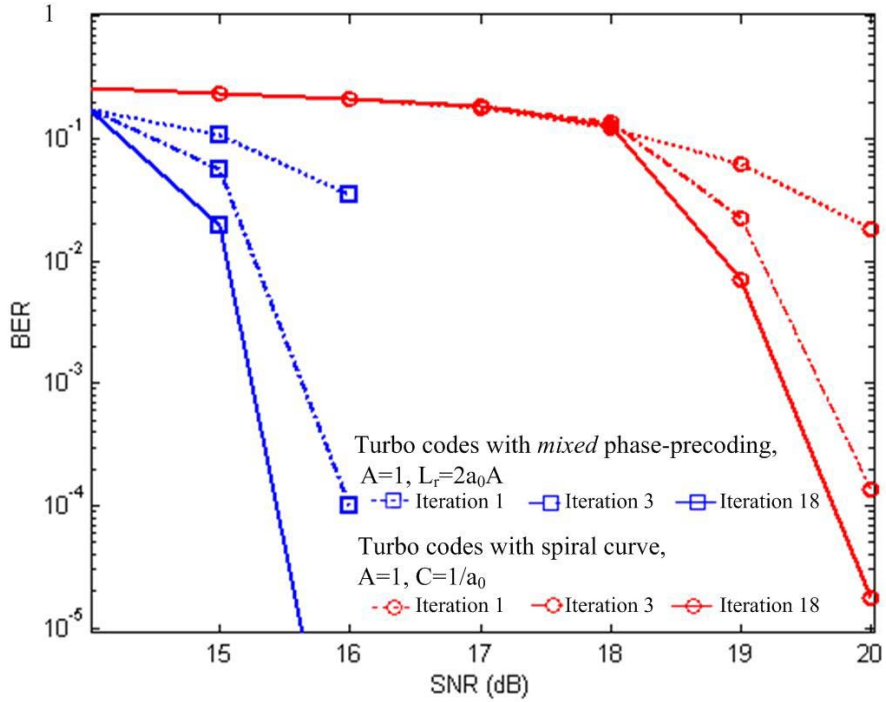
Channel

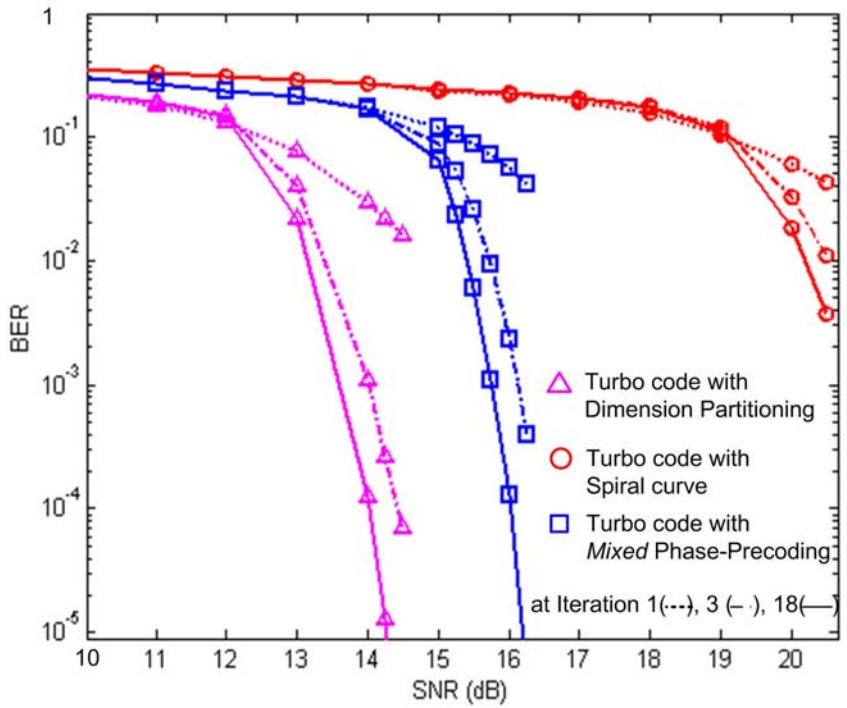
- Frequency-selective Rayleigh fading channel

- two equal strength rays of Raleigh fading channel

- Discrete-time model (Delay is one symbol period T)

Simulation results (cont.)



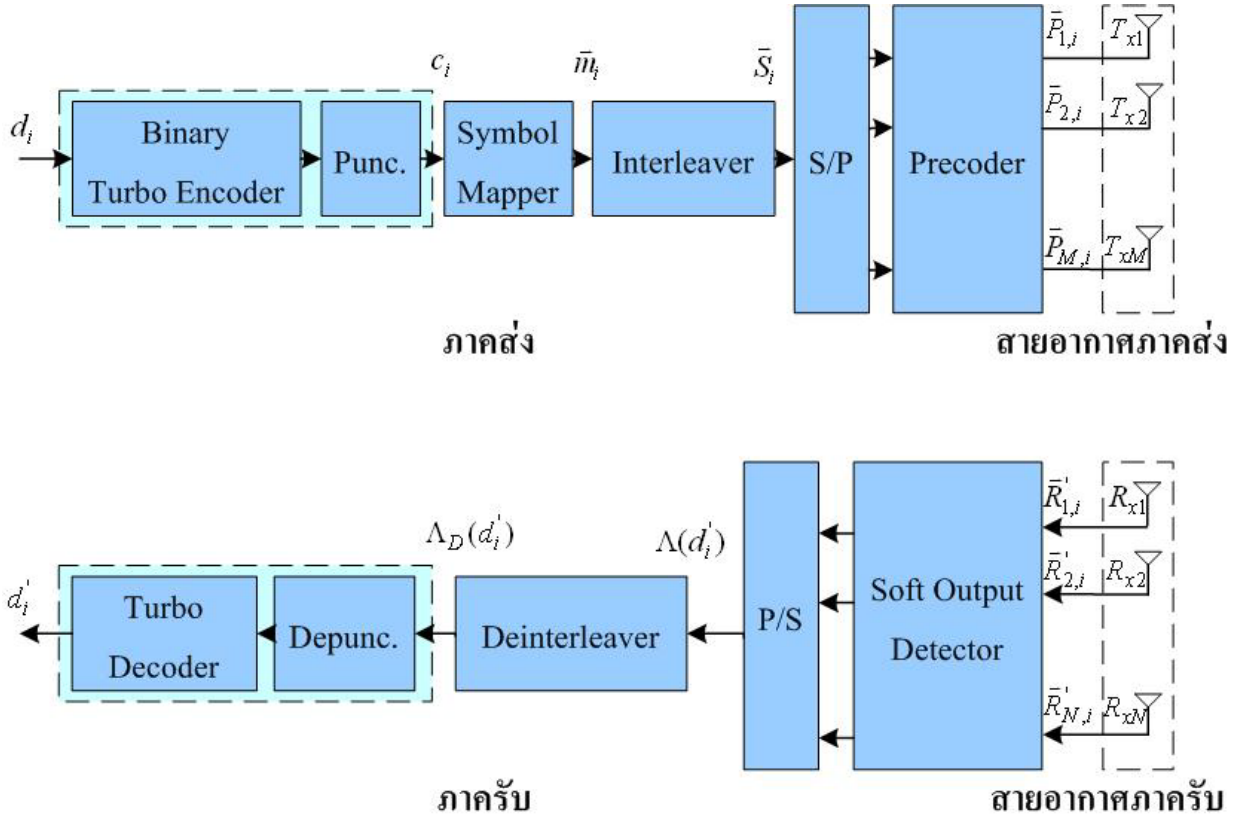


- BPSK
- QPSK with Gray code mapping

Parameter of turbo codes

- $G = [1,(1+D+D^2+D^4)/(1+D^3+D^4)]$, *Code Rate = 1/2, block size = 1024 bits*
- *Log MAP Turbo decoder*
- *Internal Interleaver is Pseudo-random Interleaver*
- *Symbol Interleaver is Block Interleaver*

Future work (on MIMO Communication systems)



Development for applications in MIMO (Multiple-Input Multiple-Output) Communication systems will be based on Space-time coding techniques.

Conclusion

- This research is a development of Turbo codes and *Pre*-Equalization that aims to combat effects of noise and Intersymbol Interference in wireless communications.
- Modification methods of Spiral curve and Dimension Partitioning, for working with turbo codes, are considered in previous works.
- In order to gets a better results for applications with and without turbo codes, this research proposed a new type of phase precoding called "*Mixed* Phase-Precoding".
- Simulation results shows that it has a better performance compared with using of spiral curve at the same systems.
- For future works, application of these proposed transmission model on MIMO systems (based on space-time coding techniques) will be investigated.