Digital Communications Laboratory

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Autumn 2020

Chapter Six

Spread Spectrum Digital Communications

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Section A

Spread Spectrum Principles

Use Cases and Benefits

Use cases:

- Military applications
- Location and time acquisition
- Basis for 2G, 3G, and LTE

Benefits:

- ISI rejection
- Bandwidth-sharing

Forms:

- Direct sequence (DS)
- Frequency hopping (FH)

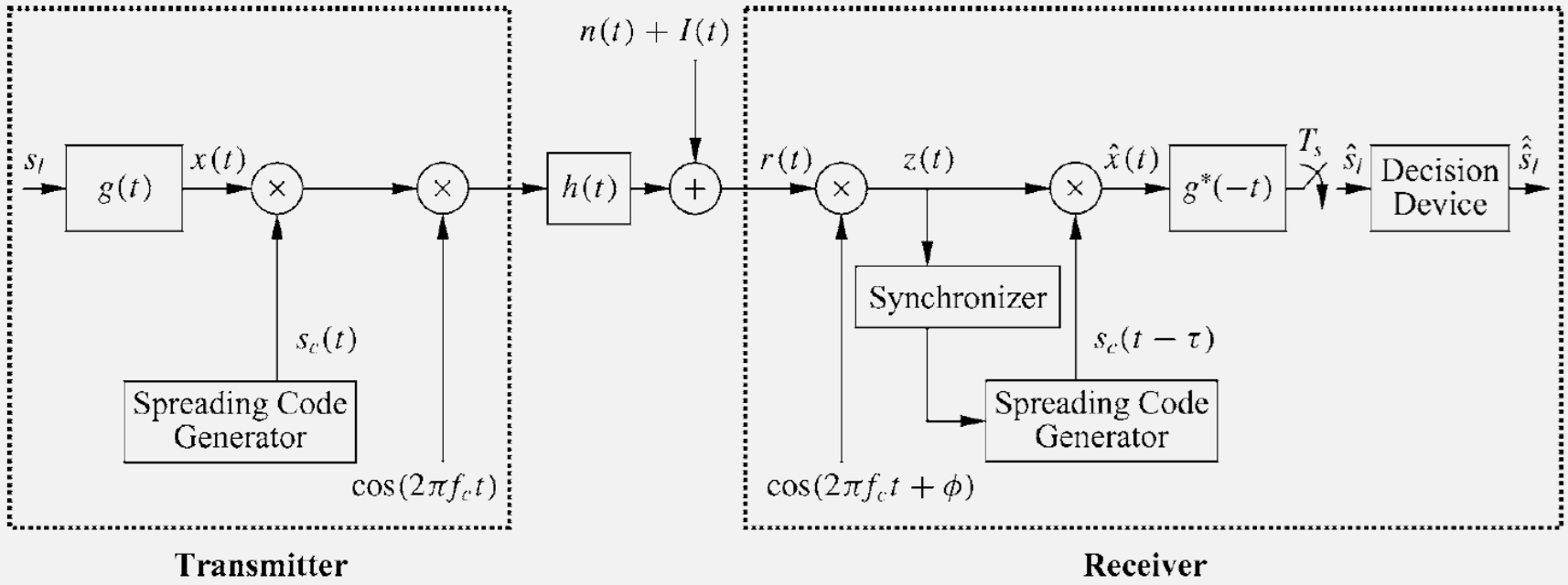
Main properties:

1. The occupied bandwidth must be larger than is needed for the information signal
2. The spread-spectrum modulation is done using spreading code, which are independent of the main data
3. De-spreading at the receiver must be done exploiting a synchronized copy of the spreading code.

Section B

Direct Sequence Spread Spectrum

System Model



$$B_{tot} = B_c + B$$

$$B_c \approx \frac{1}{T_c}$$

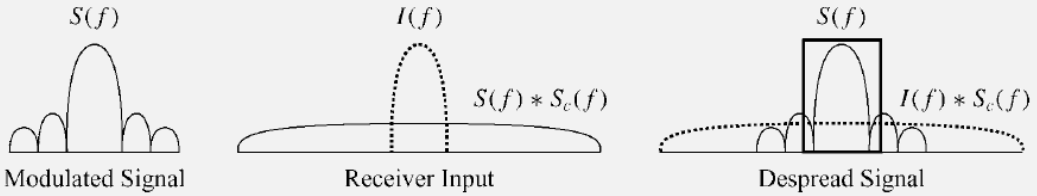


Figure 13.2: Narrowband interference rejection in DSSS.

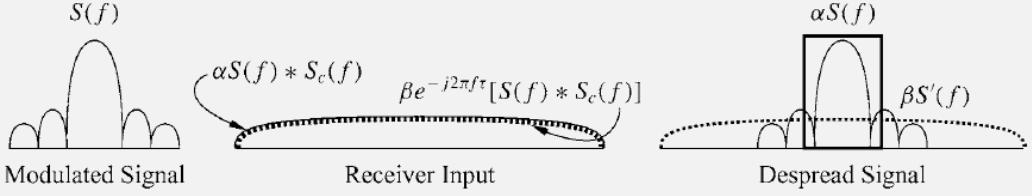


Figure 13.3: ISI rejection in DSSS.

Section C

Frequency Hopping Spread Spectrum

System Model

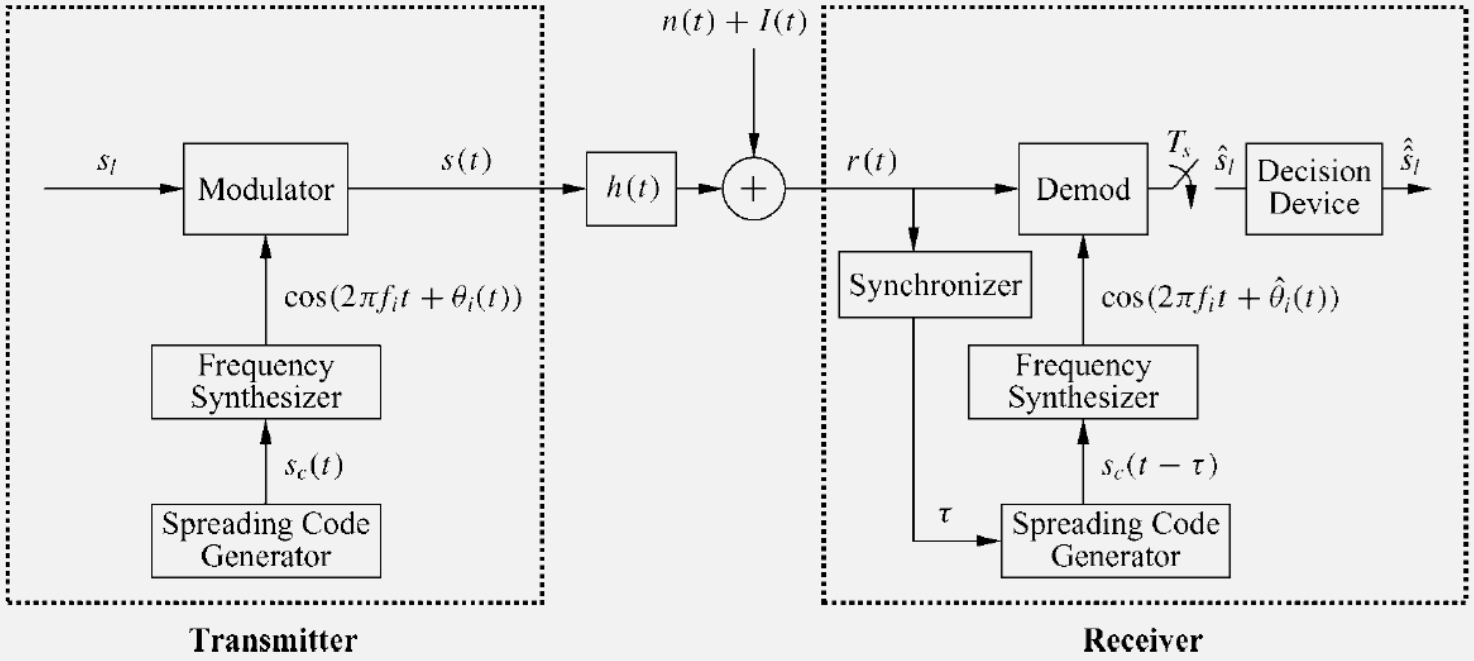


Figure 13.11: FHSS system model.

$$B_{tot} = NB$$

$$B_c \approx \frac{1}{T_c}$$

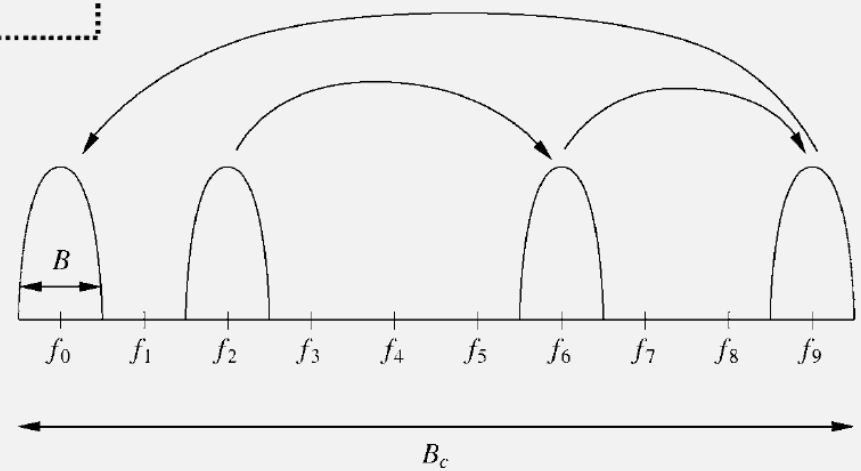


Figure 13.4: Frequency hopping.

FHSS Types:

1. SFH: Hopping/Symbol =1
2. FFH: Hopping/Symbol >1

Assignments

Session Nine

Problem:

Design the transmitter of DSSS and FHSS

Due: Dec. 1, 2020