

## Chapter 5

### Conclusions

#### 5.1 Summary

Pseudo-noise (PN) acquisition is an important task of a receiver using the spread-spectrum techniques. We studied and improved the PN acquisition in this thesis. First, in Chapter 1 an introduction of spread spectrum systems was given. We reviewed the history of PN acquisition and gave a summary in Chapter 2. Conventional PN acquisition schemes and the new PN acquisition schemes were also presented in Chapter 2.

In Chapter 3, a closed-loop noncoherent PN acquisition scheme for DS/SS systems was proposed. The system consists of two subsystems: the VCC loop and the phase alignment detector. An auxiliary signal is used in the VCC loop so that the loop adjusts the phase difference between the auxiliary signal and the incoming PN signal towards one of the two stable points. The phase alignment detector periodically checks to see if the phase difference is sufficiently close to one of the two stable points. If it is, the tracking circuit is initiated. Otherwise, the VCC loop keeps on adjusting itself.

The performance of the proposed scheme was evaluated by simulation. It was found that the proposed scheme acquires the phase much faster than the conventional noncoherent serial scheme by 3-4 folds, with a reduction in the variance of the acquisition time by 20 to 40 times.

In Chapter 4, we proposed an acquisition scheme with a closed-loop phase update using a new auxiliary signal. The proposed scheme consists of a phase alignment detector and a VCC loop. The VCC loop has 2 stable points at 0 and  $NT_c/2$  and the phase alignment detector has two correlators to check the stable points. We found that the proposed scheme acquires the phase faster than the conventional coherent serial scheme by 3-4 times with a variance of the acquisition time reduced by 10 to 40 times.

According to simulation results of both proposed schemes, we see that the proposed coherent scheme acquires the correct phase faster than the proposed noncoherent scheme, but the coherent scheme uses less hardware than the noncoherent scheme.

## 5.2 Possible Topics for Further Research

Several topics deserve further investigation. They are listed as follows:

(1) The new auxiliary signal  $x(t)$  in Chapter 4 can be applied to the noncoherent system by using idea of Chapter 3. If we do that, the VCC loop will have 4 stable points. Therefore, the phase alignment detector needs 4 branches of correlators for detection all stable points. It is expected that acquisition time can be further reduced; however the hardware increases.

(2) Designing closed-loop coherent and noncoherent PN acquisition receivers to operate in the presence of data transmission. Both auxiliary signals in this work could be used.

(3) The effects of multiple user interference, multipath, and channel fading were ignored in this work. It is of practical use to analyze the performance of the presented receivers in the presence of multiple user interference, multipath, and channel fading. From such analysis, modification, or improvement of the receivers can be made to reduce these effects.

(4) Other auxiliary sequences can be designed to obtain further improvement in the system performance. For example, we can design an auxiliary signal, which has 3 stable points to be used with the VCC loop.