Appendix A

The Signal Term in SelDLL

In this appendix, we derive an expression for the signal term, s_m in the SelDLL scheme, which is defined in (3.7) as

$$s_m = \frac{1}{T_c} \int_{(q-n)T_c}^{qT_c} \left[c(t-\tau) c(t-mT_c) \right] dt, \tag{A.1}$$

where τ is defined in (3.3). With the value of τ, we obtain

$$s_m = \frac{1}{T_c} \int_{(q-n)T_c}^{qT_c} \left[c(t-\beta T_c - \gamma T_c) c(t-mT_c) \right] dt. \tag{A.2}$$

The integration can be written as a summation of n integrations, each with a length of T_c. Substituting (3.2) into (A.2) yields

$$s_m = \frac{1}{T_c} \sum_{i=q-n}^{q-1} \int_{iT_c}^{(i+1)T_c} \left\{ \left[\sum_{j=-\infty}^{\infty} c_j P_{T_c}(t-\beta T_c - \gamma T_c - jT_c) \right] \left[\sum_{k=-\infty}^{\infty} c_k P_{T_c}(t-mT_c-kT_c) \right] \right\} dt. \tag{A.3}$$

Within the interval $iT_c \le t < (i+1)T_c$ the local PN sequence is constant, which is equal to c_{i-m}, while the received PN sequence may change, due to the offset time γT_c. For the received signal, the first duration of γT_c, the sequence is $c_{i-\beta-1}$ and the remaining duration of $(1-\gamma)T_c$, the sequence is $c_{i-\beta}$. Therefore, (A.3) is simplified to

$$\begin{aligned} s_m &= \frac{1}{T_c} \sum_{i=(q-n)}^{q-1} c_{i-m} \left[\int_{iT_c}^{(i+\gamma)T_c} c_{i-\beta-1} dt + \int_{(i+\gamma)T_c}^{(i+1)T_c} c_{i-\beta} dt \right] \\ &= \frac{1}{T_c} \sum_{i=q-n}^{q-1} c_{i-m} \left[\gamma T_c c_{i-\beta-1} + (1-\gamma) T_c c_{i-\beta} \right] \\ &= \gamma \sum_{i=0}^{n-1} c_{q-n-m+i} c_{q-n-\beta-1+i} + (1-\gamma) \sum_{j=0}^{n-1} c_{q-n-m+j} c_{q-n-\beta+j}. \end{aligned} \tag{A.4}$$