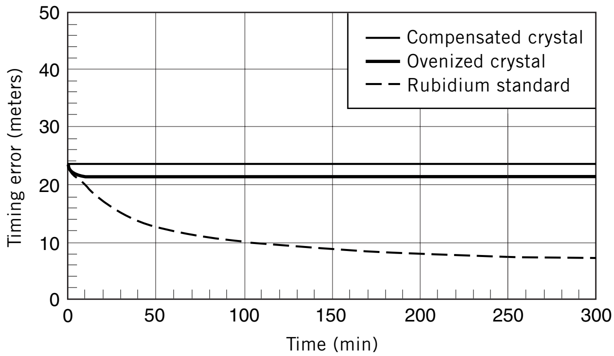

Figure 11.8 Time error profiles showing convergence and steady-state characteristics of time-transfer models for crystal and rubidium standards.

The main problem here is to estimate the desired parameter χ. Clearly, a single measurement is insufficient to separate the value of χ from the contribution of the other three error components. Instead, we can use a Kalman filter to estimate the various components separately using observations made over time. The degree of success to which this can be done depends on how different the components are spectrally. Of course, the long-term correlated error component (λ_ρ) with a time constant on the order of tens of minutes is sufficiently different spectrally than the selective availability dither (σ_ρ) time constant that is about several minutes. Also, the pseudorange tracking noise (ν_ρ) is uncorrelated between samples in time. What remains to determine the Kalman filter's ability to obtain a good estimate of χ is dependent on the stability of χ itself. In other words, the steady-state error variance of the χ estimate is influenced by how much uncertainty there is about the true value of χ as it randomly varies over a given period of time.

This can be illustrated with a covariance analysis performed using the very error model described above. Figure 11.8 shows the error standard deviation of the χ estimate for different clocks. What this means is that time transfer is more accurate with increasing clock stability. (See MATLAB M-file ex11_1.m for the details of this simulation.) ■

11.4 GPS DYNAMIC ERROR MODELS USING INERTIALLY DERIVED REFERENCE TRAJECTORY

The reference trajectory approach to integrating information derived from different sensors has been successfully used for many types of navigation systems (see Chapter 10). Positioning information from a GPS sensor can similarly be handled with this approach using the complementary filter methodology that was