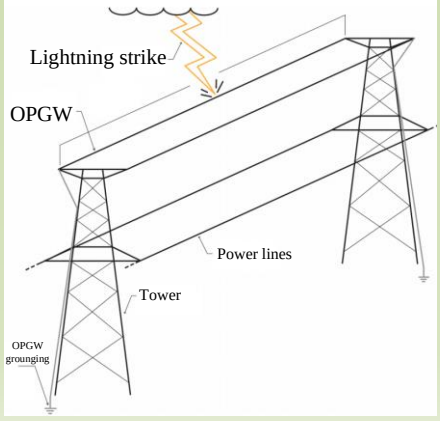
Simplified Radius-directed Linear Kalman Filter for Blind Polarization Demultiplexing of PDM-QPSK Signal

Introduction

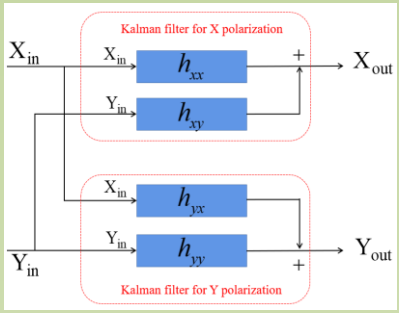
Optical ground wire (OPGW) combines the functions of communication and lightning protection, and has advantages of low transmission loss and high communication quality. Lightning events can cause the ultra-fast rotation of the state of polarization (RSOP) and phase changes in optical transmission fibers due to strong electrical currents and magnetic fields. The measured fastest RSOP speed exceeded 8 Mrad/s. The industry arrived at a consensus that lightning strikes into OPGW cables can lead to traffic interruptions in metro and longhaul networks.



we proposed a simplified radiusdirected linear Kalman filter (S-RD-LKF) of blind polarization demultiplexing for PDM-QPSK signal.

Principle

The S-RD-LKF scheme was designed to realize polarization demultiplexing by two independent Kalman filters

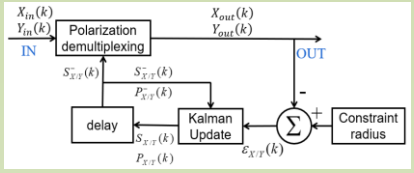


$$H(k)=[X_{in}(k) \quad Y_{in}(k)]$$

$$S_X(k)=[h_{xx}(k) \quad h_{xy}(k)]^T$$

$$S_Y(k)=[h_{yx}(k) \quad h_{yy}(k)]^T$$

$$U_{X/Y}(k)=H(k)\cdot S_{X/Y}(k)+v_{X/Y}(k)$$



$$S^-_{X/Y}(k)=S_{X/Y}(k-1)$$

$$P^-_{X/Y}(k)=P_{X/Y}(k-1)+Q$$

$$K_{X/Y}(k)=P^-_{X/Y}(k)\cdot H^{*T}(k)\cdot C$$

$$C=[H(k)\cdot P^-_{X/Y}(k)\cdot H^{*T}(k)+R]^{-1}$$

$$\varepsilon_{X/Y}(k)=U_{X/Y}(k)/|U_{X/Y}(k)|-U_{X/Y}(k)$$

$$S_{X/Y}(k)=S^-_{X/Y}(k)+K_{X/Y}(k)\cdot\varepsilon_{X/Y}(k)$$

$$P_{X/Y}(k)=P^-_{X/Y}(k)-K_{X/Y}(k)\cdot H(k)\cdot P^-_{X/Y}(k)$$

Conclusion

We proposed and demonstrated a S-RD-LKF scheme of blind polarization demultiplexing for PDM-QPSK signal. The simulation results showed that the S-RD-LKF has about the same tracking capability for ultra-fast RSOP as the RD-LKF. Compared with the RD-LKF, the S-RD-LKF scheme reduces 75% computational complexity in the case of 23 taps, the S-RD-LKF can be more conducive to hardware implementation of DSP.