Let’s investigate the Alamouti code Rahul et al. allude to in Section 6 of the paper. Recall that the two senders don’t know the channel to the (one) receiver, because of residual frequency offset errors.

The Alamouti scheme works over two consecutive timeslots, during which we will assume the channel from transmitter 1 to receiver \((h_1)\) and the channel from transmitter 2 to receiver \((h_2)\) are both unchanging. During these two timeslots, the senders will transmit two symbols, \(s_1\) and \(s_2\). Let’s further assume there are no other noise sources or transmitters around.

In timeslot 1, sender 1 transmits \(s_1\) and sender 2 transmits \(s_2\).

In timeslot 2, sender 1 transmits \(-s_2^*\) and sender 2 transmits \(s_1^*\), where \((\cdot)^*\) is the complex conjugate operator.

Let’s denote the signal the receiver gets in timeslot 1 as \(y_1\) and the signal the receiver gets in timeslot 2 as \(y_2\).

1. Show that the receiver can recover \(s_1\) by computing \(h_1^* y_1 + h_2^* y_2^*\).

2. Suggest a method whereby the receiver can recover \(s_2\) and show it works.

3. Rahul et al. mention the scenario where \(h_1 = -h_2\). Why does this method work in that case?