A Study of TX/Electrode Noise on ERT Measurements

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In electrical resistivity tomography (ERT) surveys, the same electrodes are often used as both transmitters and receivers. To study this error source, tests were carried for different metal electrodes. These tests included both "experienced" electrodes from previous field projects and electrodes that were sanded and cleaned with a descaling compound. The study used 100% duty cycle waveforms from 0.75 Hz to 7.5 Hz. The electrode responses are dominated by the final transmitter pulse so the A response is negative and the B positive. For each test, four electrodes were tested with each serving as both an A and B electrode.

The upper panel shows electrode voltage responses for cleaned stainless steel electrodes at source currents of 50 and 400 ma. These have been filtered to remove powerline harmonics. Both A and B responses are roughly of the form $(t) \cong a\,(t+b)^{-\frac{1}{2}} + c$. Responses are largest at early times and at high currents but there are significant errors at long times and at low current flows. The responses are very nonlinear with respect to source current and even very small source current can produce electrode error voltages of hundreds of millivolts.

The lower panel of the figure shows the estimated errors in processed voltages for progressively higher order stacking approaches. Here, the order of the stack method, *n*, is highest order polynomial, t^n, which is removed by the stack method. For example, for *n*=0, the lowest order stack approach, the stacked voltage, $V_0(t)$, at time, *t*, is given by $V_0(t) = ½(\,v(t) - v(t+h))$, where *h* is ½ waveform length. This stack approach will remove a constant voltage offset but won't remove voltages that vary linearly with time. In this test, for *n*=0, the resulting error voltages are greater than 1 mV for time as late as 30 seconds. However, high order stack approaches drop the electrode response below the system/site noise floor in about 8 seconds.

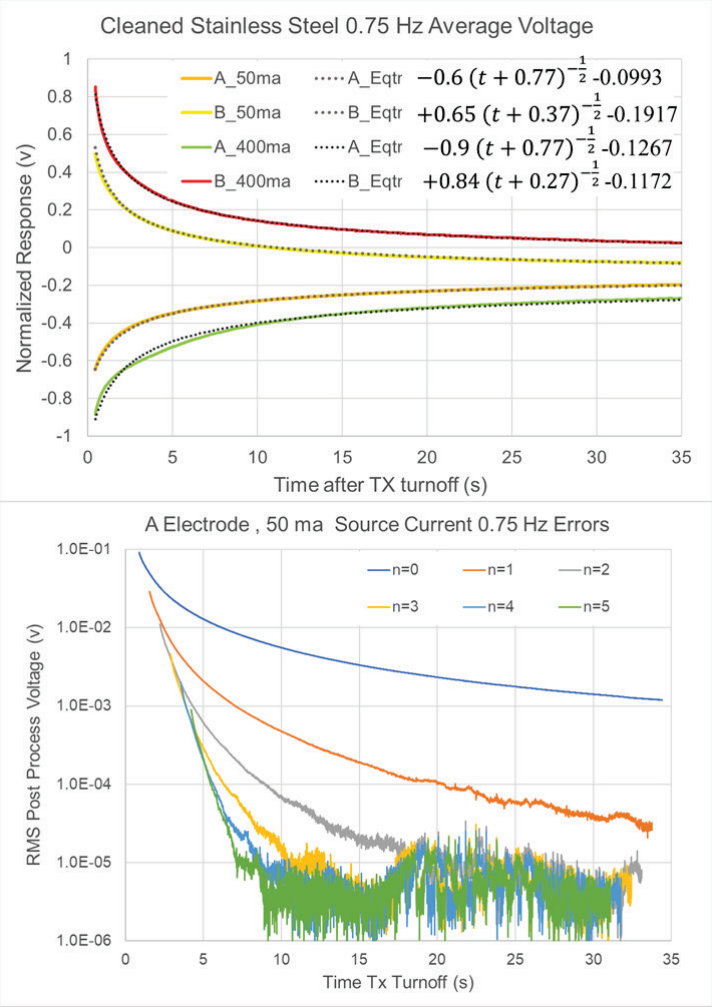

Figure: The upper graph shows the voltage decays due to transmitter charging cleaned, stainless-steel electrodes. The lower graph shows the root-mean-squared errors for single stacks with orders from 0 through 5. Each filter has n+1 points and the plot point is the center time of the stack sequence.