\procssng\working\interchange_filter_integration.tex

Another example of the interchangeability of filtering and integration

To once again check the interchangeability of integration and filtering, I did some processing on 0530c_u.smc, using program bl_fltr.for. I did the following:

1. Try to reproduce the displacement available on the web site by doing a constrained quadratic fit to the velocity, with integration followed by separate filtering (using a low-cut causal Butterworth filter with 0.02 Hz corner and nroll = 2). The displacement file resulting from this is 53q_fsd.smc, where "q" and "fs" stand for **q**uadratic fit and **f**ilter **s**eparately.

2. Do a constrained quadratic fit to the velocity, with filtering (using a low-cut causal Butterworth filter with 0.02 Hz corner and nroll = 2) followed by integration. The displacement file resulting from this is 53qxfsd.smc, where "q" and "xfs" stand for **q**uadratic fit and not **f**ilter **s**eparately.

3. Do a constrained quadratic fit to the velocity, with integration but no filtering. The displacement file resulting from this is 53qxf_d.smc, where "q" and "xf" stand for **q**uadratic fit and no **f**ilter.

4. Filter the trace made using only the quad fit, with no baseline correction. This was done to make sure that the result of cascading bl_fltr on time series is the same as doing baseline correction and filtering in the same run of bl_fltr. The displacement file resulting from this is 53qxf02d.smc, where "q" and "xf" stand for **q**uadratic fit and no **f**ilter, and "02" is the corner frequency of the low-cut filter.

The results as shown in the figure below. All the filtered traces are identical, confirming the interchangeability of integration and filtering. Note that this holds for a baseline correction constrained to be 0.0 at t = 0.0, so that there is no initial velocity, and for a causal filter. If either of these conditions do not hold, the interchangeability might break down. I think that with appropriate leading and trailing pads, however, acausal filtering should be OK. I've done some comparisons of causal and acausal filtering in /akkar/, but I did not also look into the interchangeability of integration and filtering.

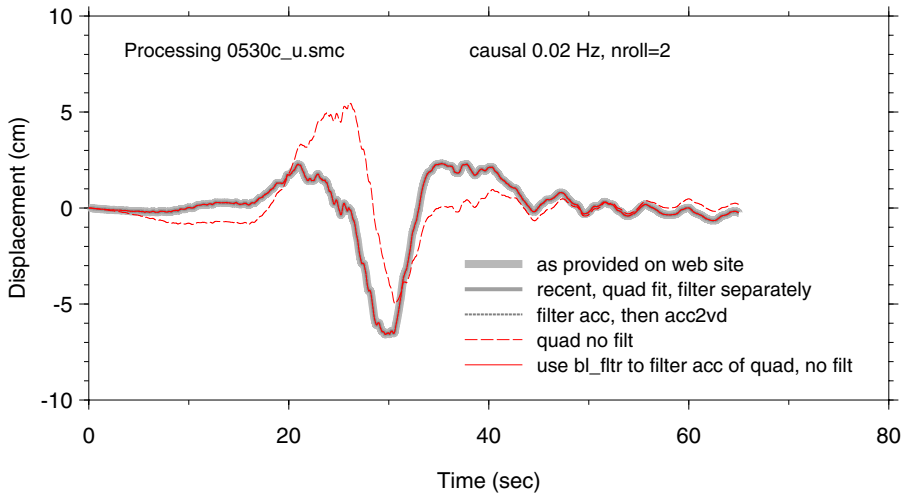

Figure. Displacements using different processing.