Protocol for fling-step removal and application to the Chi-Chi Earthquake strong ground motion dataset

http://www.ce.2 wsu.edu/Faculty_Staff/Profiles/rodriguez-marek/research/NF.htm.

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Protocol for fling-Step removal for the Chi-Chi Earthquake

There are two motions in the hanging wall. These motions are also located near the end of the fault where the fault normal and fault parallel directions are not clear (because of the bend in the fault). For these motions, I did the following

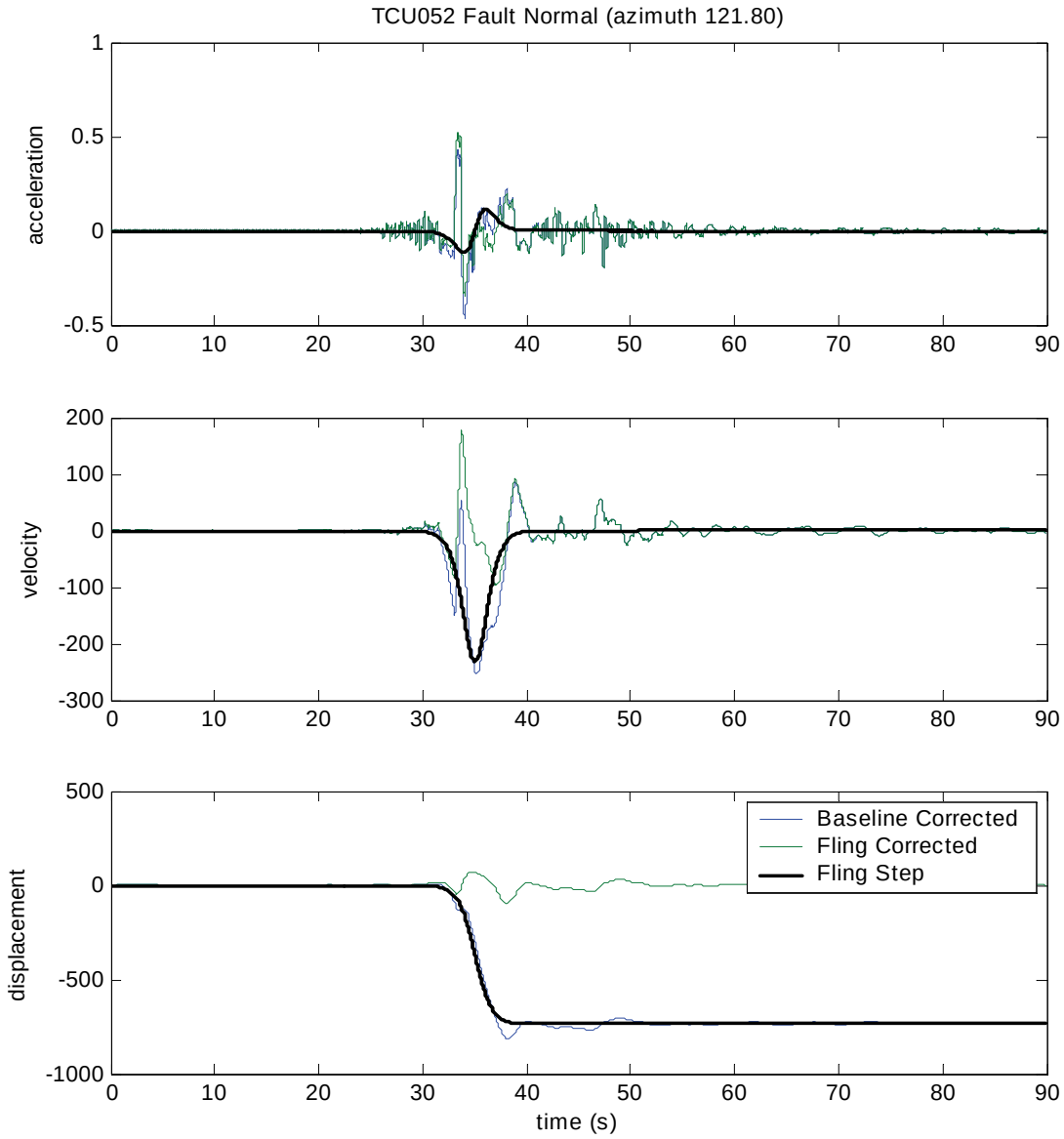
1) Do an initial baseline correction of the original records (both components). This correction implies only removing the pre-event average from the whole acceleration time history
2) I rotate the motion to the direction of maximum acceleration (where it is more likely that the fling step is located)
3) Do a baseline correction of the motion that comes AFTER the fling step
4) Remove the fling step following the recommendations outlined by Helen Rathje (e.g., fit a tanh function)
5) Rotate the motions to the orientation of maximum velocity.

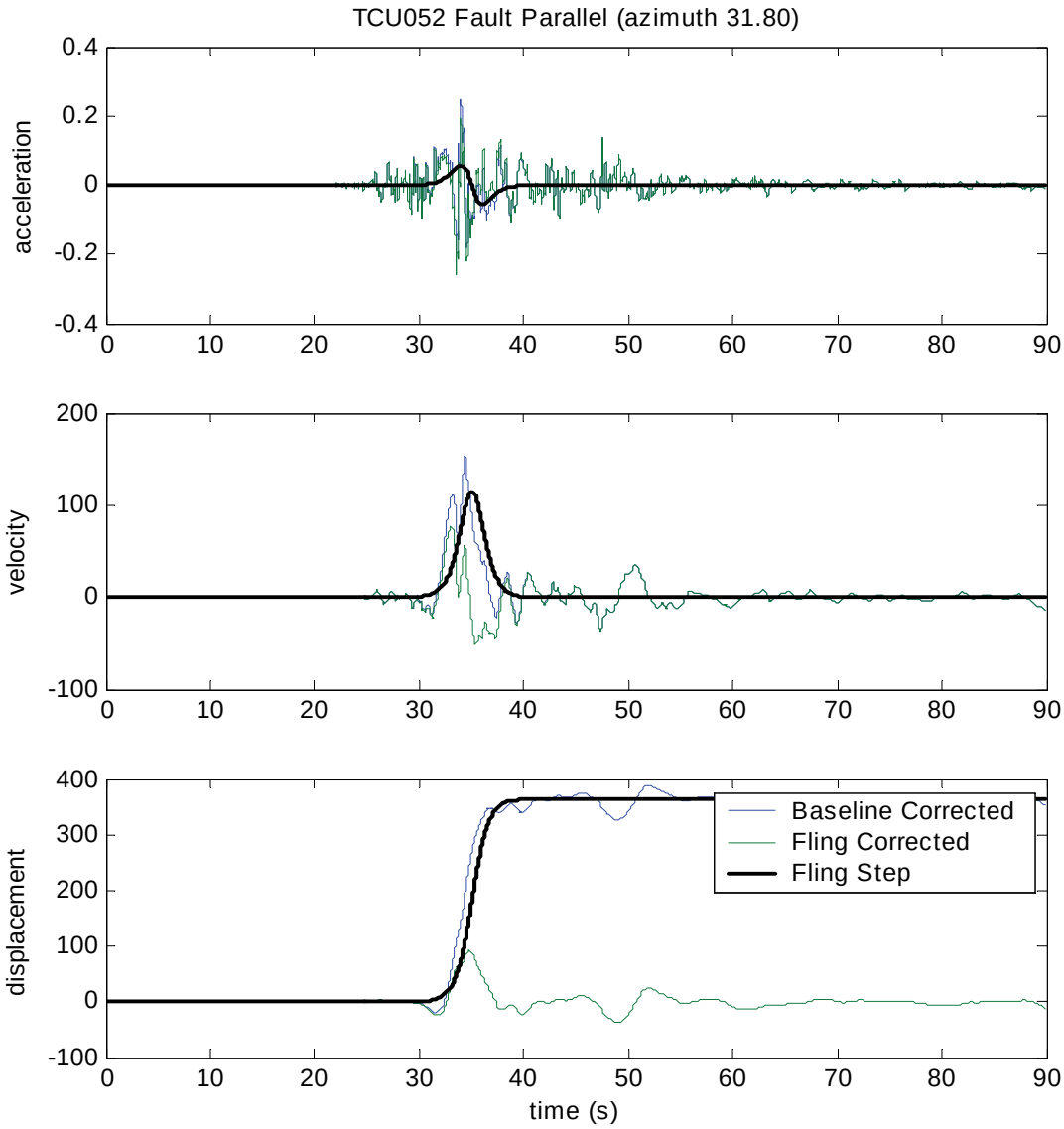
In both of the motions in the hanging wall, the fling has a similar orientation (Azimuth of 328.1 in TCU052, Azimuth of 323.2 in TCU068). The peak velocity is oriented at an azimuth of 121.80 in TCU052 and an azimuth of 159.35 in TCU068. These orientations more or less match the orientation of the faul near to these motions.

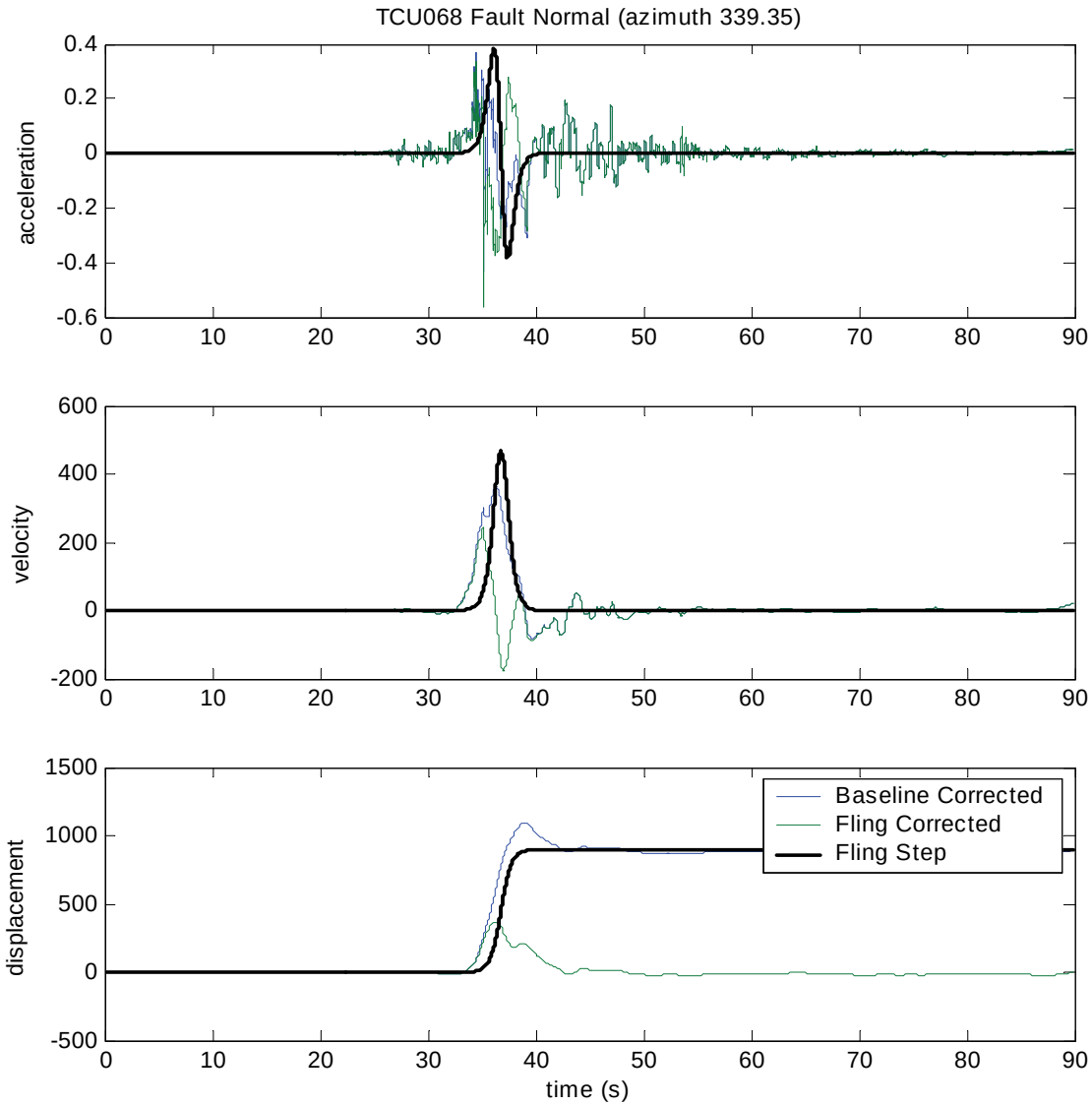
Note that we can't determine before doing the fling step removal what is the orientation of maximum velocity, and the rotation to this orientation (STEP 4) offsets a little bit the fling step correction.

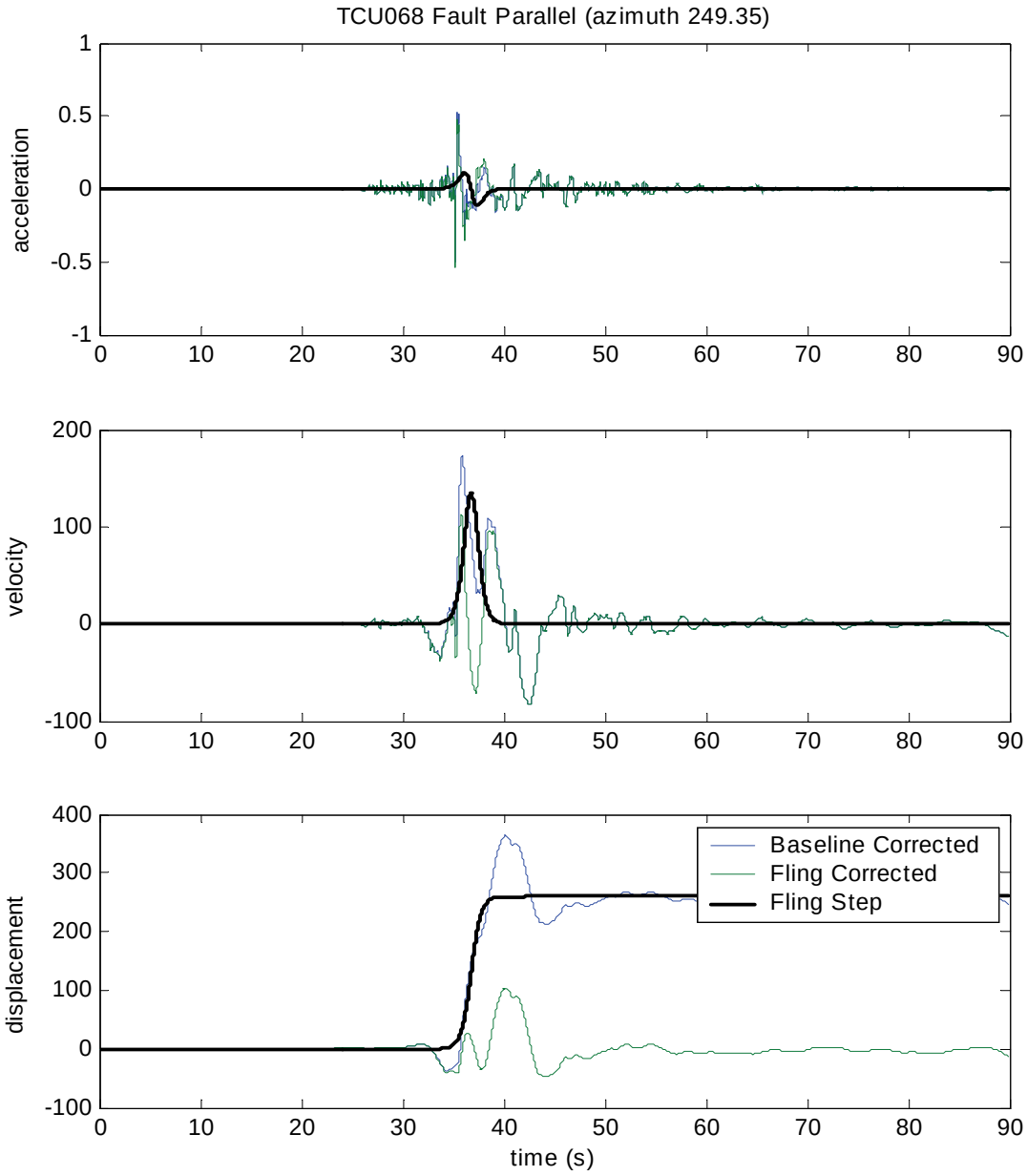
Finally, of all the sites in the foot wall, TCU075 (only at 1.4 km from the fault) is affected by the fling step. I do not know why, but it is clear when you look at the motions. In fact, the dynamic component of TCU075 does not even look like a near-fault recording.

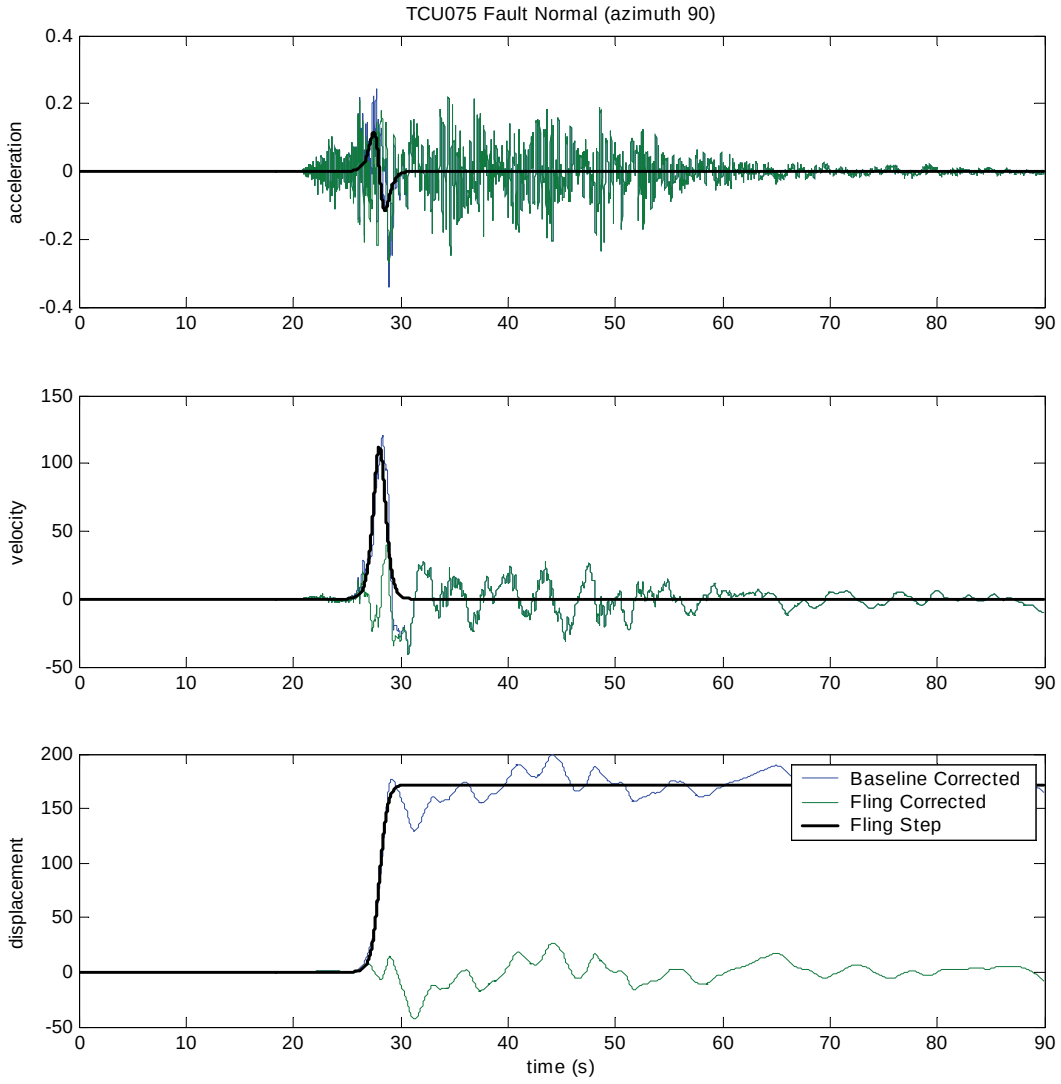
I do not expect TCU101, TCU102, and TCU103 to have a fling step.


TCU052 Fault Normal (azimuth 121.80)
acceleration
velocity
displacement
time (s)
Baseline Corrected
Fling Corrected
Fling Step


TCU052 Fault Parallel (azimuth 31.80)
acceleration
velocity
displacement
time (s)
Baseline Corrected
Fling Corrected
Fling Step


TCU068 Fault Normal (azimuth 339.35)
acceleration
velocity
displacement
time (s)
Baseline Corrected
Fling Corrected
Fling Step


TCU068 Fault Parallel (azimuth 249.35)
acceleration
velocity
displacement
time (s)
Baseline Corrected
Fling Corrected
Fling Step


TCU075 Fault Normal (azimuth 90)
acceleration
velocity
displacement
time (s)
Baseline Corrected
Fling Corrected
Fling Step

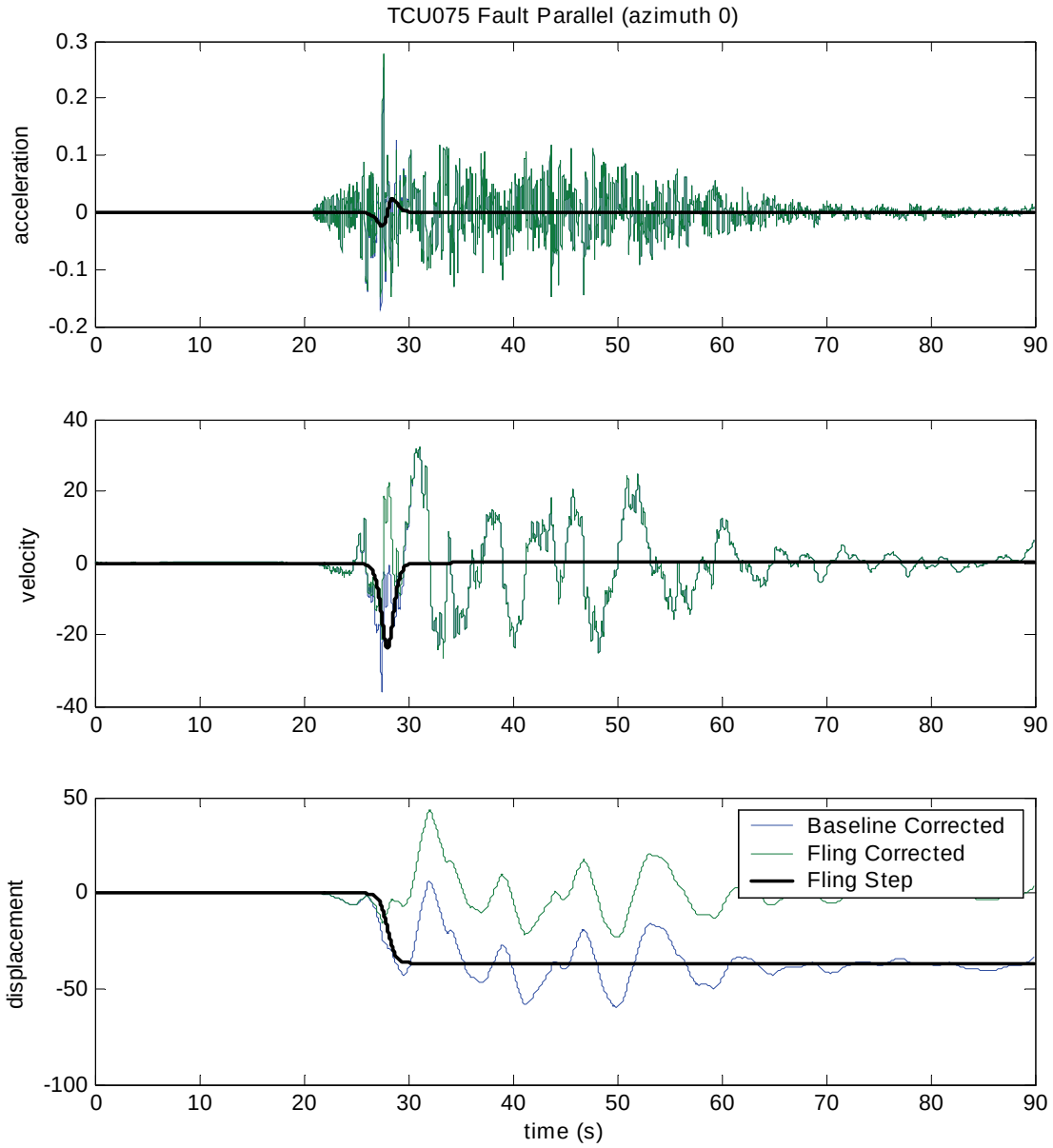

TCU075 Fault Parallel (azimuth 0)
acceleration
velocity
displacement
time (s)
Baseline Corrected
Fling Corrected
Fling Step

Table 1 I summarizes the results of the fling step removal. In Table 2 I compare my results with those published by Boore (BSSA 91, 5, pp1199-1211), and with those of Norm for the few motions I had available from Norm.

Table 1. Summary of results of fling step removal

Motion	R	Location	Azimuth of Fling Step	Max. Permanent Displacement (cm)	Azimuth of PGV (dynamic component only)	PGV (cm/s)	NOTES	US AN
TCU052	0.2	HW	328.1	802.5	121.78	177.2	Station is near north end of the fault where the fault starts to turn. I would be inclined to take the FN direction as that of maximum velocity because otherwise it is hard to tell what to use for fault normal	**YE** orie vel
TCU068	1.0	HW	328.2	979.8	199.0	188.5	Station is at the location where the fault's strike is EW, thus the orientation of the PGV (nearly south) matches the fault normal direction	**YE** orie vel pul obs dire
TCU075	1.4	FW	102.8	141.2	100.1	77.3	(See TCU102 in table 2 for justification of doing a fling step removal for a FW motion)	**YE** Fau
TCU101	2.9	FW	90	47.7			Fling step occurs before the dynamic pulse. Has no effect on our pulse parameters	**YE** effe wo tha con all
TCU102	1.7	FW	104.7	55.2			Same as TCU101	**YE**
TCU103	4						**NO FLING STEP**	**YE**

Table 2. Comparison of permanent static displacements (in cm) with those obtained by Boore (2001, BSSA 91,5) using a time-domain baseline correction. Values from Boore are read from figures in the paper and are note exact. GPS station displacements are obtained from Boore (2001) and are also approximate. GPS stations are not collocated with the strong motion stations. The distance from GPS station to SM station is indicated in the table.

MOTION	Boore (EW)	Ours (EW)	Norm (EW)	GPS Stations	Boore (NS)	Ours(NS)	Norm (NS)	GPS Stati
TCU052	-510	-423	-419	G104(6.5 km): -280 AF25(8.3 km): -500	690	682	726	G104 (8.3 AF25(8.3
TCU068	-580	-516.3	-511.7	G104(4.3 km): -280	620	832.7	N.A.	G104 (4.3
TCU075	N.A.	137.7	N.A	N.A.	N.A.	-31.2	-29.6	N.A.
TCU102	75	53.3	N.A	G103 (1.7 km) 70	Varies*	-14.0	N.A	G103 (1.7

*Depending on correction scheme