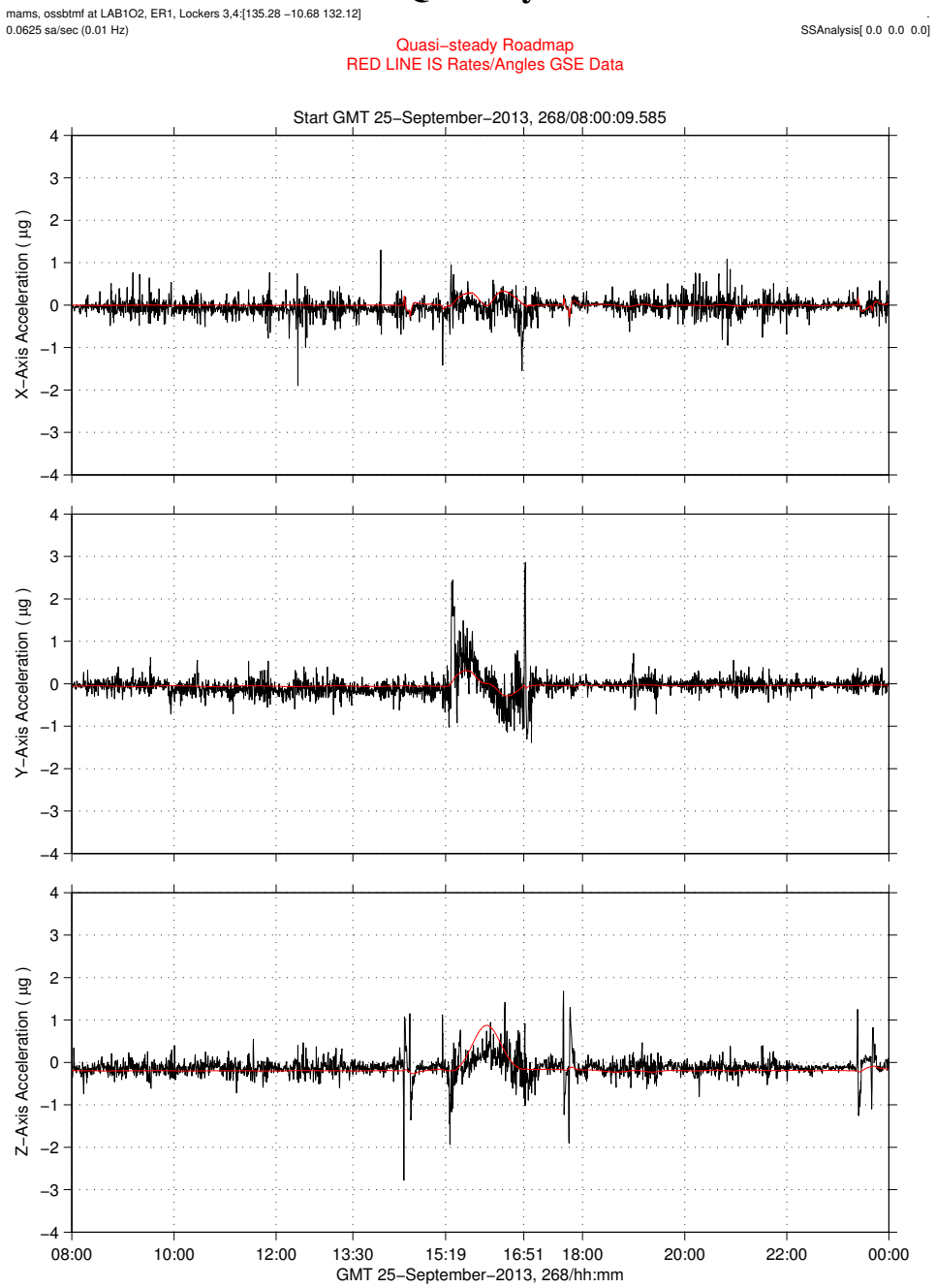
Optimal Propellant Maneuver (OPM) to -XVV Attitude Quantify



Description	
Sensor	MAMS, OSSBTMF 0.0625 sa/sec (0.01 Hz)
Location	LAB1O2, ER1, Lockers 3,4
Plot Type	Acceleration versus time

Notes:

- The sequence shown on the last page in conjunction with the MAMS measurements shown here indicate that the primary quasi-steady disturbance during the OPM was on the Z-axis.

Regime:	Vibratory
Category:	Vehicle
Source:	Optimal Propellant Maneuver

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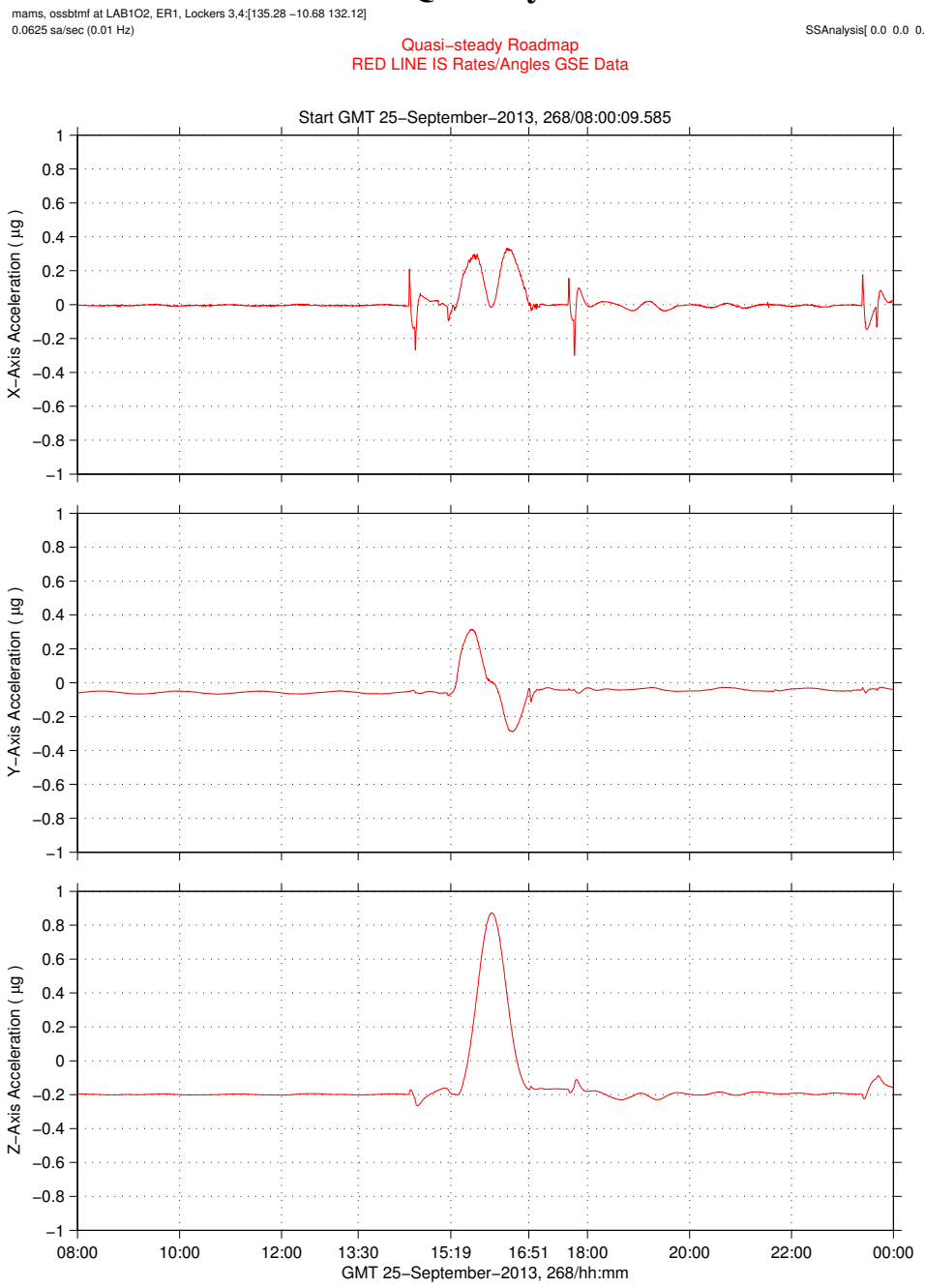

Description	
	ISS Rates/Angles Data
Plot Type	Acceleration versus time

Notes:

- The sequence shown on the last page in conjunction with the ISS rates/angles derived data shown here clearly show the quasi-steady effects during the OPM.

GMT	Accel Peak (ug)	Remarks
9/25/2013 15:19:00	-	OPM begins
9/25/2013 15:43:01	0.31	y-axis positive peak
9/25/2013 15:49:29	0.29	x-axis peak #1
9/25/2013 16:07:16	0.86	z-axis positive peak
9/25/2013 16:28:16	0.32	x-axis peak #2
9/25/2013 16:33:07	-0.28	y-axis negative peak
9/25/2013 16:51:00	-	OPM ends

Regime:	Vibratory
Category:	Vehicle
Source:	Optimal Propellant Maneuver

OPM to -XVV
Ancillary Information

Maneuver Start-Stop GMT	Beta Angle	Attitude Name	Ref. Frame	YPR	F/T Cfg.	Event	Remarks
						OPM to -XVV (M13_268_A_10.UAF)	9/25/2013
268/15:14	24	+XVV	LVLH	354	MMT	Transition to USTO	
—		+ZLV		356.8	UST		
		TEA		0.6			
268/15:19	24	-XVV	LVLH	177	UST	Mnvr to -XVV using OPM	Not a pure Eigen axis rotation
268/16:51		+ZLV		356.8	UST		reference chit 11703 for attitude profile
				0.6			
268/16:51	24	-XVV	LVLH	175	UST	Mnvr to TEA on USTO	
268/16:56		+ZLV		357.3	UST		
		TEA		0.6			
268/17:04	24	-XVV	LVLH	175	UST	Transition to Momentum Management using USTO	TEA for VV#3az_N2neze, PSARJ auto, SSARJ auto
—		+ZLV		357.3	MMT		
		TEA		0.6			

The space station had to maneuver and essentially rotate 180 degrees in preparation for the Soyuz 36S docking. Once the Soyuz was docked, the station maneuvered back again to its original attitude. These rotation maneuvers are typical for dockings, and usually these two 180-degree maneuvers would cost roughly 320 kilograms of propellant, which accounts for approximately one-fifth of the total fuel brought by the Progress cargo vehicle. This fuel delivery comes with a multi-million dollar cost, so NASA along with engineers from Draper employed a sophisticated algorithm that took into account all the various forces that affect how the station moves. They then exploit those forces to effectively steer the ISS along an optimal path in terms of fuel consumption; not optimal in terms of time spent. Executing this algorithm to make a full rotation took about 90 minutes. This is much longer than it would take using the less fuel-efficient, but simpler calculations that ultimately get the job done via controlled thruster firings.*

*http://spectrum.ieee.org/tech-talk/aerospace/satellites/nasa-saves-big-on-fuel-in-iss-rotation