OARE Data Recording During the STS-107 Mission

OARE Description

The Orbital Acceleration Research Experiment (OARE) contains a tri-axial accelerometer used to measure high resolution, low-frequency quasi-steady accelerations in support of the microgravity scientific community. Quasi-steady accelerations are composed primarily of three components: vehicle drag, rotational effects (as the Orbiter rotates about its center of mass), and gravity gradient effects. The quasi-steady accelerations are extracted from the raw OARE data and are on the order of a few μg. The raw OARE data are on the order of tens of μg. By using a dual gimbal platform, OARE has the capability to perform on-orbit bias and scale factor calibrations. The relevance of this on-orbit calibration capability to the OARE data collected during the STS-107 mission will be discussed later.

OARE records data at a rate of 10 samples per second over the frequency range 0-1 Hz. Data are provided in units of μg. This 10 sample per second data is referred to as raw OARE data. During the STS-107 mission and several other microgravity dedicated missions, the raw OARE data were transmitted to the Payload Recorder (PLR) for subsequent downlink to ground computers. OARE has a filtered version of its data that are recorded on-board OARE. These filtered data are retrieved from the OARE post-mission at the Kennedy Space Center.

Per OARE Technical Report # 152, the nominal ranges and instrument resolutions for each of ranges A, B, and C are provided in Table 1.

Table 1 - OARE Instrument Ranges and Resolution

	Nominal Full Scale Range in micro-Gs	
Range	**X-Axis**	**Y & Z Axes**
A	10,000	25,000
B	1,000	1,970
C	100	150
	Resolution in nano-Gs SF_N in nano-Gs/count	
Range	**X-Axis**	**Y & Z Axes**
A	305.2	762.9
B	30.52	60.12
C	3.052	4.578

In Orbiter structural coordinates, the OARE was located at:

$$[X_O, Y_O, Z_O] = (1153.14, 1.313, 317.932) \text{ inches.}$$

This is the standard OARE location and was pulled from previous OARE mission summary reports (STS-94 (MSL-1R) and STS-87 (USMP-4)).

OARE Coordinate System.

Two coordinate systems are typically used when working with OARE data; the OARE axes centered at the OARE sensor proof mass centroid and the Orbiter aircraft body axes centered at the Orbiter's center of gravity. The direction from tail to nose of the orbiter is +X in both the OARE coordinate system and the Orbiter body coordinate system. The direction from port wing to starboard wing is +Z in the OARE coordinate system and +Y in the Orbiter body coordinate system. The direction from the Orbiter belly to the top of the Orbiter fuselage is +Y in the OARE coordinate system and -Z in the Orbiter body coordinate system. The data provided are stored in the OARE coordinate system.

Data Availability

For previous missions where raw OARE data were transmitted to the PLR, the entire mission's set of raw OARE data were collected on ground computers. Due to downlink resource limitations and the fact that OARE was supporting specific scientific investigations with its raw OARE data, a complete set of raw OARE data was not dumped from the PLR and is subsequently not available. The first PLR dump was received at GMT 22-Jan-2003, 022/10:45:23 and the last PLR dump was received at GMT 31-Jan-2003, 031/06:45:07. Numerous PLR dumps were received between these times. Table 2 and Table 3 provide GMT and MET times for data gaps in the raw OARE data. The OARE data provided is stored in a GMT time reference.

Note: Total OARE data we received and processed was ~52 hours.

Table 2 - Raw OARE Data Gaps MET 005 - 010

MET Gap Start Time	MET Gap Stop Time	GMT Gap Start Time	GMT Gap Stop Time
005/20:26:23	005/20:36:23	022/12:05:23	022/12:15:23
005/21:55:27	005/21:56:23	022/13:34:27	022/13:35:23
005/23:16:23	006/10:01:36	022/14:55:23	023/01:40:36
006/11:26:24	006/14:27:40	023/03:05:24	023/06:06:40
006/15:45:48	006/15:47:04	023/07:24:48	023/07:26:04
006/15:47:12	006/15:47:36	023/07:26:12	023/07:26:36
006/15:48:08	006/15:56:24	023/07:27:08	023/07:35:24
006/17:16:25	006/20:56:25	023/08:55:25	023/12:35:25
006/23:05:45	007/02:23:29	023/14:44:45	023/18:02:29
007/03:35:33	007/03:46:25	023/19:14:33	023/19:25:25
007/04:25:37	007/07:19:49	023/20:04:37	023/22:58:49
007/10:56:26	007/19:34:27	024/02:35:26	024/11:13:27
007/20:45:55	007/20:46:27	024/12:24:55	024/12:25:27
007/21:26:27	008/01:03:39	024/13:05:27	024/16:42:39
008/03:35:23	008/08:06:31	024/19:14:23	024/23:45:31
008/08:35:35	008/08:36:27	025/00:14:34	025/00:15:27
008/10:45:31	008/10:46:27	025/02:24:31	025/02:25:27
008/12:05:31	008/12:06:27	025/03:44:31	025/03:45:27
008/12:45:43	009/01:43:32	025/04:24:43	025/17:22:32
009/04:20:04	009/04:20:08	025/19:59:04	025/19:59:08
009/04:20:24	009/04:26:28	025/19:59:24	025/20:05:28
009/04:35:52	009/08:16:32	025/20:14:52	025/23:55:32
009/09:15:44	009/09:16:28	026/00:54:43	026/00:55:28
009/09:29:24	009/09:29:28	026/01:08:24	026/01:08:28
009/10:36:28	009/13:25:52	026/02:15:28	026/05:04:52
009/13:46:29	009/13:55:24	026/05:25:29	026/05:34:24
009/14:36:09	009/14:36:28	026/06:15:09	026/06:15:28
009/15:35:45	009/18:56:29	026/07:14:45	026/10:35:29
009/19:45:53	009/19:46:29	026/11:24:53	026/11:25:29
009/22:36:13	010/02:36:17	026/14:15:13	026/18:15:17
010/04:56:29	010/09:11:38	026/20:35:29	027/00:50:38
010/11:28:10	010/11:28:14	027/03:07:10	027/03:07:14
010/11:29:22	010/11:29:26	027/03:08:22	027/03:08:26
010/11:33:06	010/11:33:10	027/03:12:06	027/03:12:10
010/11:35:10	010/11:35:14	027/03:14:10	027/03:14:14
010/11:36:30	012/06:06:36	027/03:15:30	028/21:45:36

Table 3 - Raw OARE Data Gaps MET 012 - 014

MET Gap Start Time	MET Gap Stop Time	GMT Gap Start Time	GMT Gap Stop Time
012/06:15:44	012/07:46:32	028/21:54:44	028/23:25:32
012/08:06:32	012/08:56:32	028/23:45:32	029/00:35:32
012/09:16:32	012/09:46:32	029/00:55:32	029/01:25:32
012/10:06:32	012/12:26:32	029/01:45:32	029/04:05:32
012/12:46:32	012/13:56:32	029/04:25:32	029/05:35:32
012/14:16:32	012/17:36:32	029/05:55:32	029/09:15:32
012/17:45:40	012/18:36:32	029/09:24:40	029/10:15:32
012/18:46:33	012/20:26:33	029/10:25:33	029/12:05:33
012/20:36:29	012/22:46:33	029/12:15:29	029/14:25:33
012/23:06:33	012/23:36:33	029/14:45:33	029/15:15:33
012/23:56:33	013/00:26:33	029/15:35:33	029/16:05:33
013/00:55:41	013/01:16:33	029/16:34:41	029/16:55:33
013/01:46:33	013/04:35:25	029/17:25:33	029/20:14:25
013/04:55:57	013/05:36:33	029/20:34:57	029/21:15:33
013/05:55:29	013/13:36:33	029/21:34:29	030/05:15:33
013/14:06:33	013/15:56:33	030/05:45:33	030/07:35:33
013/16:17:42	013/16:17:57	030/07:56:42	030/07:56:57
013/16:18:14	013/16:18:17	030/07:57:14	030/07:57:17
013/16:18:34	013/16:18:37	030/07:57:34	030/07:57:37
013/16:18:46	013/16:18:49	030/07:57:46	030/07:57:49
013/16:19:02	013/16:19:05	030/07:58:02	030/07:58:05
013/16:19:26	013/16:19:29	030/07:58:26	030/07:58:29
013/16:19:38	013/17:26:34	030/07:58:38	030/09:05:34
013/17:56:34	013/18:46:34	030/09:35:34	030/10:25:34
013/19:06:06	013/20:43:18	030/10:45:06	030/12:22:18
013/20:56:14	013/21:36:34	030/12:35:14	030/13:15:34
013/21:56:14	013/23:26:34	030/13:35:14	030/15:05:34
013/23:45:30	014/00:48:42	030/15:24:30	030/16:27:42
014/01:05:54	014/02:36:34	030/16:44:54	030/18:15:34
014/03:05:42	014/04:26:34	030/18:44:42	030/20:05:34
014/04:55:34	014/09:06:34	030/20:34:34	031/00:45:34
014/09:46:34	014/09:56:34	031/01:25:34	031/01:35:34
014/10:26:34	014/10:46:34	031/02:05:34	031/02:25:34
014/11:05:55	014/11:06:34	031/02:44:55	031/02:45:34
014/11:36:35	014/12:17:42	031/03:15:35	031/03:56:42
014/12:56:35	014/13:46:35	031/04:35:35	031/05:25:35
014/14:25:39	014/14:26:35	031/06:04:39	031/06:05:35

OARE Bias Operations and Acceleration Data During Bias Calibrations

Some considerations need to be taken into account when using the raw OARE data that are available. A primary consideration is the fact that the raw OARE data contains bias calibration and scale factor calibration data within the data set. The dual gimbal platform OARE operates on allows the accelerometer to be rotated in order to measure instrument bias and instrument scale factor performance. While such table rotations are actively occurring, the OARE acceleration data are useless and must be ignored. Table 4 shows, in MET and GMT, the start and stop times for bias calibration and scale factor calibrations. These data from bias and scale factor calibration periods have not been removed from the raw OARE data set.

The OARE was operated in its two nominal modes during the STS-107 mission. In normal mode, bias calibrations occur every 432 minutes and all three instrument ranges are calibrated. In quiet mode, bias calibrations occur every 158 minutes and only the most sensitive range (C-range) is calibrated.

Table 4 OARE Bias and Scale Factor Calibration Times

MET Bias Start Time	MET Bias Stop Time	GMT Bias Start Time	GMT Bias Stop Time
005/19:43:31	005/19:47:19	2003-01-22 11:22:31	2003-01-22 11:26:29
005/22:25:03	005/22:28:47	2003-01-22 14:04:03	2003-01-22 14:07:47
006/15:26:52	006/15:38:32	2003-01-23 07:05:52	2003-01-23 07:17:32
006/22:50:09	006/23:01:41	2003-01-23 14:29:09	2003-01-23 14:38:41
006/23:01:45	006/23:05:41	2003-01-23 14:40:45	2003-01-23 14:44:41
007/21:00:07	007/21:11:47	2003-01-24 12:39:05	2003-01-24 12:50:45
008/11:46:43	008/11:58:23	2003-01-25 03:25:41	2003-01-25 03:37:21
009/02:33:20	009/02:45:00	2003-01-25 18:12:18	2003-01-25 18:23:58
009/09:56:36	009/10:08:20	2003-01-26 01:35:36	2003-01-26 01:47:20
013/17:26:34	013/17:34:38	2003-01-30 09:05:34	2003-01-30 09:13:38
014/00:48:42	014/00:57:54	2003-01-30 16:27:42-	2003-01-30 16:36:53

- shaded entry is for an OARE scale factor calibration. All other entries are bias calibrations

OARE Data ASCII Data File Contents

Each ASCII file contains six columns: time, x-axis acceleration, y-axis acceleration, z-axis acceleration, OARE temperature (degrees C), and OARE status byte. The time column is a relative time to the time embedded in the beginning portion of the filename. For the OARE data file,

2003_01_22_10_45_23.753-2003_01_22_12_05_23.715.oare.ascii

The time column is relative to **2003_01_22_10_45_23.753.** Add the time column value to this time to get the actual time for a particular record.

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