DeMi Requirements

ID	Statement	Parent Requirement	Rationale	Verification Method	Revision date	Expert Contact
example	The system shall…	MLR-4	Mission goal, etc.	Analysis	2/15/2013	kerberosUserna
Mission Statement						
MS-1	The mission of the Deformable Mirror Demonstration (DeMi) is to provide a low-cost, quick access platform to demonstrate microelectromechanical system (MEMS) deformable mirror technology on orbit.				2/18/2013	zaira
Mission Level Requirements						
MLR-1	The system design shall follow a 3-unit CubeSat platform.	MS-1	Low-cost, quick access space platform	Inspection	2/23/2013	zaira, acarlton
MLR-2	The system shall primarily use commercial off the shelf (COTS) and CubeSat parts and components.	MS-1	Low-cost option for a university project	Inspection	2/23/2013	zaira, acarlton
MLR-3	The system shall accommodate and operate a MEMS deformable mirror demonstration experimental payload.	MS-1	Mission goal	Inspection	2/23/2013	zaira, acarlton
MLR-4	The system shall operate and produce operational and experimental data for a period of <3 months> [goal of 12 months].	MS-1	Mission goal	Analysis	2/23/2013	zaira, acarlton
System Requirements						
SYS-1	The system shall survive launch conditions.	MLR-4	Safety and mission requirement	Testing	2/18/2013	zaira
SYS-2	The system shall include electrical, mechanical, and software interfaces to the payload.	MLR-3	Mission requirement	Inspection	2/18/2013	zaira
SYS-3	The system shall comply with the requirements and constraint listed in the most current CubeSat Design Specification (CDS) document.	MLR-1	CDS is the standard for CubeSat mission design	Inspection	2/23/2013	zaira
SYS-4	The system shall be capable of sending and receiving data and instructions to and from the ground.	MLR-3, MLR-4	Mission requirement	Testing	2/18/2013	zaira
SYS-5	The system shall have a deorbit time of 25 years or less.	MLR-4	Current regulation	Analysis	2/23/2013	zaira
ADCS Subsystem Requirements						
ADCS-1	ADCS shall meet payload performance requirements during external-source science operation mode				3/8/2013	
ADCS-1.1	ADCS shall meet 4.7'/s slew rate requirement of payload imaging technology during external source science operation mode	MLR-3	Payload requirement	Lab testing, Analysis	3/8/2013	tamz, alewasse
ADCS-2	ADCS shall provide attitude knowledge and control during communication operation	SYS-4			3/1/2013	
ADCS-2.1	ADCS shall provide attitude knowledge of the satellite to an accuracy within 10 degrees for communication operations.	SYS-4	Communication requirement	Lab testing, Analysis	3/1/2013	tamz, alewasse
ADCS-2.2	ADCS shall provide attitude control of the satellite to an accuracy within 15 degrees for communication operations.	SYS-4	Communication requirement	Analysis	3/1/2013	tamz, alewasse
ADCS-3	ADCS shall provide momentum capability to despin upon launch vehicle separation within 30 days.	MLR-4	Detumbling requirement	Analysis	3/8/2013	tamz, alewasse
Avionics Subsystem Requirements						
AVI-1	Avionics shall provide the necessary interfaces to support all subsystems.	MLR-3, SYS-2	Required for operation	Analysis	2/23/2013	zjcasas, dominicg
AVI-1.1	The avionics system shall be able to communicate over UART interface	AVI-1	Interface with transiever	Analysis	5/13/2013	eremin
AVI-1.2	The avionics system shall be able to communicate over I2C interface	AVI-1	Interface with power distribution module	Analysis	5/13/2013	eremin
AVI-1.3	The avionics system shall be able to communicate over SPI interface	AVI-1	Interface with magnetometer	Analysis	5/13/2013	eremin
AVI-2	Avionics shall handle calculations required to run all subsystems in real time.	MLR-3, SYS-2	Required for operation	Lab testing	2/23/2013	zjcasas, dominicg
AVI-3	Avionics shall write and store data to a mass storage device onboard the satellite.	MLR-4, SYS-2	Data downlink not always available	Lab testing	2/23/2013	zjcasas, dominicg
AVI-3.1	The mass storage device shall be able to receive and store data from the payload at an average rate of TBD kbps.	AVI-3		Lab testing	5/13/2013	eremin
AVI-3.2	The mass storage device shall store at most 2 GB of data.	AVI-3		Lab testing	5/13/2013	eremin
AVI-4	Avionics shall permit software updates and be capable of reprogramming in orbit.	SYS-2	Reconfigurability	Lab testing	2/23/2013	zjcasas, dominicg

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AVI-5	Avionics shall be able to recover from potential single event effects.	MLR-4	Required for operation in space environment	Analysis	2/23/2013	zjcasas, dominicg
Communication Subsystem Requirements						
Comm-1	The subsystem at the satellite shall receive commands from the ground station, and transmit telemetry and image packets to the ground station.	MLR-4, SYS-4	Mission requirement	Lab testing	5/12/2013	zjcasas
Comm-2	The communications subsystem shall establish a robust and periodic link.	MLR-4, SYS-4	Required for operation	Lab testing	5/12/2013	zjcasas
Comm-2.1	The subsystem shall recognize correct packets from incorrect packets and request retransmission if the packet is faulty.	Comm-2	Maintain data integrity	Lab testing	5/12/2013	zjcasas
Comm-2.2	The subsystem shall store packets to prevent overflow.	Comm-2	Prevent data loss	Lab testing	5/12/2013	zjcasas
Comm-2.3	The subsystem shall identify missing packets and out of order packets.	Comm-2	Maintain data integrity	Lab testing	5/12/2013	zjcasas
Comm-3	The communications subsystem shall support a bandwidth and data rate necessary to transmit all telemetry and images.	MLR-4, SYS-4	Required for operation	Lab testing	5/12/2013	zjcasas
Comm-3.1	The subsystem shall transmit at 19.2 kb/s for uplink and 1.5 Mb/s for downlink.	Comm-3	Ability to transmit and receive data	Lab testing	5/12/2013	zjcasas
Comm-3.2	The subsystem shall have a bandwidth of 445-455 MHz for uplink and 460-470 MHz for downlink.	Comm-3	Ability to link with ground station	Lab testing	5/12/2013	zjcasas
Comm-4	The communications subsystem shall be able to encrypt data packets.	MLR-4, SYS-4	Required for uplink	Lab testing	5/12/2013	zjcasas
Comm-5	The communications subsystem shall downlink data with a bit error rate no greater than 10^-5%.	MLR-4, SYS-4	Ensure continuous link during contact	Lab testing	5/12/2013	zjcasas
Comm-6	The communications subsystem shall obey communications regulations.	SYS-4	Must comply with FCC, IARU regulations	Lab testing, inspection	5/12/2013	zjcasas
Orbit Subsystem Requirements						
ORB-1	The orbit altitude shall sustain under aerodynamic drag for the duration of mission life time.	MLR-4	Ensure satellite remains on orbit for mission lifetime	Analysis	3/11/3013	tamz, alewasse
ORB-2	The orbit shall have an inclination of 40 degrees for ground station access.	SYS-4	Ensure communication with ground station(s)	Analysis	3/11/3013	tamz, alewasse
Payload Subsystem Requirements						
PLD-1	The payload shall command a MEMS deformable mirror to run a pre-defined test sequence for at least 5 minutes each orbit.	MLR-3, MLR-4	Mission requirement	Analysis	5/11/2013	acarlton, kree
PLD-1.1	The payload shall have the ability to control any combination of actuators within 0.001 seconds of each other, at a minimum rate of 100 Hz, with a minimum stroke of 1.5 microns, and with a precision of at least 1 nm.	PLD-1	Need to be able to control individual actuators and the DM as a whole with a certain speed, rate, stroke, and precision	Lab testing	5/11/2013	acarlton, kree
PLD-2	The payload shall have the ability to measure and reconstruct the optical wavefront at one wavelength for the duration of a 5 minute test sequence each orbit at a frequency of at least 10 Hz.	MLR-3, MLR-4	Need to be able to measure and reconstruct the wavefront in test our (theoretical) ability to correct for it.	Lab testing	5/11/2013	acarlton, kree
PLD-2.1	The payload shall have the ability to measure the optical wavefront at a minimum rate of 10 Hz for at least one minute each orbit.	PLD-2	Diagnostic mode for taking full frame images	Lab testing	5/11/2013	acarlton, kree
PLD-2.2	The payload shall have the ability to measure the optical wavefront at a minimum rate of 100 Hz for at least 30 seconds each orbit.	PLD-2	Burst mode for data capture	Lab testing	5/11/2013	acarlton, kree
PLD-2.3	The payload shall have the ability to reconstruct the optical wavefront with a minimum accuracy of 100 nm rms.	PLD-2	Need to be able to reconstruct the wavefront accurately	Lab testing	5/11/2013	acarlton, kree
Power Subsystem Requirements						
POW-1	Power subsystem shall supply 3.54 watts to power bus on average over each orbit.	MLR-3	Satellite will not operate without power.	VirSat	5/1/2013	jclark, eremin
POW-1.1	Power subsystem shall have solar panels to supply power to other systems while satellite is in sunlight and recharge batteries for eclipse.	POW-1	CubeSat is too small for nuclear power to be worthwhile, and needs to run for long periods of time (i.e. needs to be able to recharge).	VirSat	3/1/2013	jclark, eremin

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POW-1.1.1	Solar panels shall supply 3.54 watts after 12 months of operation.	POW-1.1	Need to supply sufficient power through end of mission.	VirSat	5/1/2013	jclark, eremin
POW-1.2	Power subsystem shall have rechargeable (secondary) batteries to supply power during eclipse.	POW-1	Satellite in LEO will spend up to 1/3 of its orbit in shadow, so we need to store power for that time.	VirSat	5/5/2013	jclark, eremin
POW-1.2.1	Secondary batteries shall have 6.5 watt-hours of capacity after 12 months / 6,000 cycles.	POW-1.2	Batteries decay over time so we need enough capacity to support other systems through the end of mission lifetime.	VirSat	5/14/2013	jclark, eremin
POW-2	Power subsystem shall supply 13.84 watts of power for peak operations	MLR-3	Power subsystem has to withstand maximum power draw.	Analysis and lab testing	5/1/2013	jclark, eremin
	Structural Subsystem Requirements					
STR-1	The primary structure shall be a 3U CubeSat.	SYS-3			3/18/2013	khoza, imdavid
STR-1.1	The system shall be 340.5 mm in length (x) by 100.0 mm in width (y) by 100.0 mm in height (z)	STR-1	CubeSat design specification	inspection	2/25/2013	khoza, imdavid
STR-1.2	The system shall not exceed 6.5mm in protrusion normal to the surface of the 100mm cube.	STR-1	CubeSat design specification	inspection	2/25/2013	khoza, imdavid
STR-1.3	The center of gravity of the system shall be no more than 20 mm offset from centerline.	STR-1	CubeSat design specification	inspection	2/19/2013	khoza, imdavid
STR-1.4	The structure shall be composed of Aluminum 7075 or 6061.	STR-1	CubeSat design specification	inspection	2/25/2013	khoza, imdavid
STR-1.5	The system shall have rails of hard anodized aluminum.	STR-1	CubeSat design specification	inspection	2/25/2013	khoza, imdavid
STR-1.6	The system shall pass a minimum of 1 fit check.	STR-1	CubeSat design specification	inspection	2/25/2013	khoza, imdavid
STR-2	The structure shall provide space and attachment points for the payload, the avionics system, the power system, the ADCS, and the propulsion system.	SYS-1		inspection	3/18/2013	khoza, imdavid
STR-2.1	Attachment points shall ensure no relative motion of attached modules during launch as well as during nominal operating conditions.	STR-2	Relative movement of modules could cause payload malfunction or other forms of malfunction	analysis and testing	2/17/2013	khoza, imdavid
STR-2.2	The structure shall survive thermal expansion and contraction across a range of -16 degrees C to 30 degrees C.	STR-2	some temperature variation is inevitable	analysis and testing	2/23/2013	khoza, imdavid
STR-2.3	Lowest resonant frequency of all CubeSat components shall be higher than resonant frequency of launch vehicle.	STR-2	if launch vehicle vibrations could hit resonant frequencies of the CubeSat, vibrations could result in system failures.	testing	2/17/2013	khoza, imdavid
STR-3	The structure shall facilitate interfaces between other subsystems.	SYS-2	subsystems need to recieve inputs from and send outputs to other modules.	inspection	2/23/2013	khoza, imdavid
STR-4	The structure shall support a mass of 4 kg including its own mass.	SYS-3	Mission goal	analysis and testing	2/17/2013	khoza, imdavid
STR-5	Structure shall not interfere with payload field of view.	PLD-2	Mission goal, functionality of ACDS	analysis and testing	2/25/2013	khoza, imdavid
STR-6	The structure shall allow for workmanship screening of avionics boards.	MS-1	decrease cost and likelihood of any mistakes made during manufacture	inspection	2/19/2013	khoza, imdavid
	Thermal Subsystem Requirements					
THM-1	The thermal system shall ensure that all components are kept within their survival temperature ranges for the duration of the mission.	SYS-2, MLR-3	Prevent component failure	Analysis and testing	2/25/2013	khoza, imdavid
THM-1.1	The thermal system shall ensure that the payload is kept within the range of -10 to 70 ^{o}C when not in operation	THM-1	Prevent component failure	Analysis and testing	5/12/2013	khoza, imdavid

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THM-1.2	The thermal system shall ensure that the communications subsystem is kept within the range of -40 to 80 ^{o}C when not in operation.	THM-1	Prevent component failure	Analysis and testing	5/12/2013	khoza, imdavid
THM-1.3	The thermal system shall ensure that the avionics system is kept within the range of -25 to 85 ^{o}C when not in operation.	THM-1	Prevent component failure	Analysis and testing	5/12/2013	khoza, imdavid
THM-1.4	The thermal system shall ensure that the ADCS is kept within the range of -20 to 40 ^{o}C when not in operation.	THM-1	Prevent component failure	Analysis and testing	5/12/2013	khoza, imdavid
THM-2	The thermal system shall ensure that all operating components are kept within their operating temperature ranges.	SYS-2, MLR-3	Prevent component failure	Analysis and testing	2/25/2013	khoza, imdavid
THM-2.1	The thermal system shall ensure that the payload operates in temperatures within the range of 0 to 35 ^{o}C	THM-2	Prevent component failure	Analysis and testing	5/12/2013	khoza, imdavid
THM-2.2	The thermal system shall ensure that the communications subsystem operates in temperatures within the range of -20 to 70 ^{o}C	THM-2	Prevent component failure	Analysis and testing	5/12/2013	khoza, imdavid
THM-2.3	The thermal system shall ensure that the avionics system operates in temperatures within the range of -25 to 85 ^{o}C	THM-2	Prevent component failure	Analysis and testing	5/12/2013	khoza, imdavid
THM-2.4	The thermal system shall ensure that the ADCS operates in temperatures within the range of -20 to 40 ^{o}C	THM-2	Prevent component failure	Analysis and testing	5/12/2013	khoza, imdavid
THM-3	The thermal system shall be able to monitor the temperatures of all key components.	SYS-2	Temperature data may prove invaluable for fault diagnosis	Testing	2/25/2013	khoza, imdavid