

Parameters

Status: Draft for R2013a

Spacecraft

Parameter	Writable	Plottable	Units	Description
ElapsedSecs	N	Y	s	Spacecraft Data Type: Real Number Dependency: None
ElapsedDays	N	Y	d	Spacecraft Data Type: Real Number Dependency: None
A1ModJulian	Y	Y	d	Spacecraft orbit epoch in the A.1 system and the Modified Julian format. Data Type: Real Number Dependency: None
A1Gregorian	Y	N	N/A	Spacecraft orbit epoch in the A.1 system and the Gregorian format. Data Type: String Dependency: None
TAIModJulian	Y	Y	d	Spacecraft orbit epoch in the TAI system and the Modified Julian format. Data Type: Real Number Dependency: None
TAIGregorian	Y	N	N/A	The spacecraft orbit epoch in the TAI system and the Gregorian format. Data Type: String Dependency: None
TTModJulian	Y	Y	d	The spacecraft orbit epoch in the TT system and the Modified Julian format. Data Type: Real Number Dependency: None

TTGregorian	Y	N	N/A	Spacecraft orbit epoch in the TT system and the Gregorian format. Data Type: String Dependency: None
TDBModJulian	Y	Y	d	Spacecraft orbit epoch in the TDB system and the Modified Julian format. Data Type: Real Number Dependency: None
TDBGregorian	Y	N	N/A	Spacecraft orbit epoch in the TDB system and the Gregorian format. Data Type: String Dependency: None
UTCModJulian	Y	Y	d	Spacecraft orbit epoch in the UTC system and the Modified Julian format. Data Type: Real Number Dependency: None
UTCGregorian	Y	N	N/A	Spacecraft orbit epoch in the UTC system and the Gregorian format. Data Type: String Dependency: None
CurrA1MJD	Y	Y	d	Deprecated. Spacecraft orbit epoch in the A.1 system and the Modified Julian format. Data Type: Real Number Dependency: None
X	Y	Y	km	Cartesian x-component of the spacecraft position. Data Type: Real Number Dependency: Coordinate System
Y	Y	Y	km	Cartesian y-component of the spacecraft position. Data Type: Real Number Dependency: Coordinate System
Z	Y	Y	km	Cartesian z-component of the

				spacecraft position. Data Type: Real Number Dependency: Coordinate System
VX	Y	Y	km/s	Cartesian x-component of the spacecraft velocity. Data Type: Real Number Dependency: Coordinate System
VY	Y	Y	km/s	Cartesian y-component of the spacecraft velocity. Data Type: Real Number Dependency: Coordinate System
VZ	Y	Y	km/s	Cartesian z-component of the spacecraft velocity. Data Type: Real Number Dependency: Coordinate System
SMA	Y	Y	km	Orbit semi-major axis. Data Type: Real Number Dependency: Central Body
ECC	Y	Y	N/A	Orbit eccentricity. Data Type: Real Number Dependency: Central Body
INC	Y	Y	°	Orbit inclination. Data Type: Real Number Dependency: Coordinate System Output Range: $0^\circ \leq \text{INC} \leq 180^\circ$
RAAN	Y	Y	°	Orbit right ascension of the ascending node. Data Type: Real Number Dependency: Coordinate System Output Range: $0^\circ \leq \text{RAAN} < 360^\circ$
AOP	Y	Y	°	Orbit argument of periapsis. Data Type: Real Number Dependency: Coordinate System Output Range: $0^\circ \leq \text{AOP} < 360^\circ$

TA	Y	Y	°	True anomaly. Data Type: Real Number Dependency: Central Body Output Range: $0^\circ \leq TA < 360^\circ$
MA	N	Y	°	Mean anomaly. Data Type: Real Number Dependency: Central Body Output Range: $0^\circ \leq MA < 360^\circ$ (elliptic orbits)
EA	N	Y	°	Eccentric anomaly. Data Type: Real Number Dependency: Central Body Output Range: $0^\circ \leq EA < 360^\circ$
HA	N	Y	°	Hyperbolic anomaly. Data Type: Real Number Dependency: Central Body
MM	N	Y	rad/s	Mean motion. Data Type: Real Number Dependency: Central Body
VelApoapsis	N	Y	km/s	Scalar velocity at apoapsis. Data Type: Real Number Dependency: Central Body
VelPeriapsis	N	Y	km/s	Scalar velocity at periapsis. Data Type: Real Number Dependency: Central Body
Apoapsis	N	Y	N/A	A parameter that equals zero when the spacecraft is at orbit apoapsis. This parameter can only be used as a stopping condition in the Propagate command. Data Type: Real Number Dependency: Central Body
Periapsis	N	Y	N/A	A parameter that equals zero when the spacecraft is at orbit periapsis. This parameter can only be used as a stopping condition in the

				Propagate command. Data Type: Real Number Dependency: Central Body
OrbitPeriod	N	Y	s	Osculating orbit period. Data Type: Real Number Dependency: Central Body
RadApo	Y	Y	km	Radius of apoapsis. Data Type: Real Number Dependency: Central Body
RadPer	Y	Y	km	Radius of periapsis. Data Type: Real Number Dependency: Central Body
C3Energy	N	Y	MJ/kg (km ² /s ²)	C ₃ (characteristic) energy. Data Type: Real Number Dependency: Central Body
Energy	N	Y	MJ/kg (km ² /s ²)	Specific orbital energy. Data Type: Real Number Dependency: Central Body
RMAG	Y	Y	km	Magnitude of the orbital position vector. Data Type: Real Number Dependency: Central Body
RA	Y	Y	°	Right ascension of the orbital position. Data Type: Real Number Dependency: Coordinate System Output Range: -180° ≤ RA ≤ 180°
DEC	Y	Y	°	Declination of the orbital position. Data Type: Real Number Dependency: Coordinate System Output Range: -90° ≤ DEC ≤ 90°
VMAG	Y	Y	km/s	Magnitude of the orbital velocity vector. Data Type: Real Number

				Dependency: Coordinate System
RAV	Y	Y	°	Right ascension of orbital velocity. Data Type: Real Number Dependency: Coordinate System Output Range: $-180^\circ \leq \text{RAV} \leq 180^\circ$
DECV	Y	Y	°	Declination of orbital velocity. Data Type: Real Number Dependency: Coordinate System Output Range: $-90^\circ \leq \text{DECV} \leq 90^\circ$
AZI	Y	Y	°	Orbital velocity azimuth. Data Type: Real Number Dependency: Coordinate System Output Range: $-180^\circ \leq \text{AZI} \leq 180^\circ$
FPA	Y	Y	°	Orbital flight path angle. Data Type: Real Number Dependency: Coordinate System Output Range: $0^\circ \leq \text{FPA} \leq 180^\circ$
SemilatusRectum	N	Y	km	Semilatus rectum of the osculating orbit. Data Type: Real Number Dependency: Central Body
HMAG	N	Y	km ² /s	Magnitude of the angular momentum vector. Data Type: Real Number Dependency: Central Body
HX	N	Y	km ² /s	X component of the angular momentum vector. Data Type: Real Number Dependency: Coordinate System
HY	N	Y	km ² /s	Y component of the angular momentum vector. Data Type: Real Number Dependency: Coordinate System
HZ	N	Y	km ² /s	Z component of the angular momentum vector. Data Type: Real Number

				Dependency: Coordinate System
DLA	N	Y	°	Declination of the outgoing hyperbolic asymptote. Data Type: Real Number Dependency: Coordinate System Output Range: $-90^\circ \leq \text{DLA} \leq 90^\circ$
RLA	N	Y	°	Right ascension of the outgoing hyperbolic asymptote. Data Type: Real Number Dependency: Coordinate System Output Range: $-180^\circ \leq \text{RLA} \leq 180^\circ$
Altitude	N	Y	km	Distance to the plane tangent to the surface of the specified celestial body at the sub-satellite point. GMAT assumes the body is an ellipsoid. Data Type: Real Number Dependency: Central Body
MHA	N	Y	°	Greenwich hour angle. Data Type: Real Number Dependency: Central Body Output Range: $0^\circ \leq \text{MHA} < 360^\circ$
Longitude	N	Y	°	Planetodetic longitude. Data Type: Real Number Dependency: Central Body Output Range: $-180^\circ \leq \text{Longitude} \leq 180^\circ$
Latitude	N	Y	°	Planetodetic latitude. Data Type: Real Number Dependency: Central Body Output Range: $-90^\circ \leq \text{Latitude} \leq 90^\circ$
LST	N	Y	°	Local sidereal time. Data Type: Real Number Dependency: Central Body Output Range: $0^\circ \leq \text{LST} < 360^\circ$
BetaAngle	N	Y	°	Beta angle (or phase angle) between the orbit normal vector

				and the vector from the celestial body to the sun. Data Type: Real Number Dependency: Central Body Output Range: $-90^\circ \leq \text{BetaAngle} \leq 90^\circ$
BdotT	N	Y	km	B-plane B·T magnitude. Data Type: Real Number Dependency: Coordinate System
BdotR	N	Y	km	B-plane B·R magnitude. Data Type: Real Number Dependency: Coordinate System
BVectorMag	N	Y	km	B-plane B vector magnitude. Data Type: Real Number Dependency: Coordinate System
BVectorAngle	N	Y	°	B-plane angle between the B vector and the T unit vector. Data Type: Real Number Dependency: Coordinate System Output Range: $-180^\circ \leq \text{BVectorAngle} \leq 180^\circ$
DCM11	Y	Y	(None)	Element (1,1) of the attitude direction cosine matrix. Data Type: Real Number Dependency: (None)
DCM12	Y	Y	(None)	Element (1,2) of the attitude direction cosine matrix. Data Type: Real Number Dependency: (None)
DCM13	Y	Y	(None)	Element (1,3) of the attitude direction cosine matrix. Data Type: Real Number Dependency: (None)
DCM21	Y	Y	(None)	Element (2,1) of the attitude direction cosine matrix. Data Type: Real Number

				Dependency: (None)
DCM22	Y	Y	(None)	Element (2,2) of the attitude direction cosine matrix. Data Type: Real Number Dependency: (None)
DCM23	Y	Y	(None)	Element (2,3) of the attitude direction cosine matrix. Data Type: Real Number Dependency: (None)
DCM31	Y	Y	(None)	Element (3,1) of the attitude direction cosine matrix. Data Type: Real Number Dependency: (None)
DCM32	Y	Y	(None)	Element (3,2) of the attitude direction cosine matrix. Data Type: Real Number Dependency: (None)
DCM33	Y	Y	(None)	Element (3,3) of the attitude direction cosine matrix. Data Type: Real Number Dependency: (None)
EulerAngle1	Y	Y	◦	Attitude Euler angle 1. Data Type: Real Number Dependency: (None) Output Range: $0^\circ \leq \text{EulerAngle1} < 360^\circ$
EulerAngle2	Y	Y	◦	Attitude Euler angle 2. Data Type: Real Number Dependency: (None) Output Range: $0^\circ \leq \text{EulerAngle2} < 360^\circ$
EulerAngle3	Y	Y	◦	Attitude Euler angle 3. Data Type: Real Number Dependency: (None) Output Range: $0^\circ \leq \text{EulerAngle3} < 360^\circ$
MRP1	Y	Y	(None)	Attitude modified Rodrigues

				parameter 1. Data Type: Real Number Dependency: (None)
MRP2	Y	Y	(None)	Attitude modified Rodrigues parameter 2. Data Type: Real Number Dependency: (None)
MRP3	Y	Y	(None)	Attitude modified Rodrigues parameter 3. Data Type: Real Number Dependency: (None)
Q1	N	Y	(None)	Attitude quaternion element 1 (a). Data Type: Real Number Dependency: (None)
Q2	N	Y	(None)	Attitude quaternion element 2 (b). Data Type: Real Number Dependency: (None)
Q3	N	Y	(None)	Attitude quaternion element 3 (c). Data Type: Real Number Dependency: (None)
Q4	N	Y	(None)	Attitude quaternion element 4 (d). Data Type: Real Number Dependency: (None)
Quaternion	Y	N	(None)	Attitude quaternion. Data Type: Array (1x4) Dependency: (None)
AngularVelocityX	Y	Y	°/s	X component of the attitude angular velocity vector. Data Type: Real Number Dependency: (None)
AngularVelocityY	Y	Y	°/s	Y component of the attitude angular velocity vector. Data Type: Real Number Dependency: (None)
AngularVelocityZ	Y	Y	°/s	Z component of the attitude angular

				velocity vector. Data Type: Real Number Dependency: (None)
EulerAngleRate1	Y	Y	%s	Rate of attitude Euler angle 1. Data Type: Real Number Dependency: (None)
EulerAngleRate2	Y	Y	%s	Rate of attitude Euler angle 2. Data Type: Real Number Dependency: (None)
EulerAngleRate3	Y	Y	%s	Rate of attitude Euler angle 3. Data Type: Real Number Dependency: (None)
DryMass	Y	Y	kg	Dry mass (without propellant). Data Type: Real Number Dependency: (None)
Cd	Y	Y	(None)	Coefficient of drag. Data Type: Real Number Dependency: (None)
Cr	Y	Y	(None)	Coefficient of reflectivity. Data Type: Real Number Dependency: (None)
DragArea	Y	Y	m ²	Area used to compute acceleration due to atmospheric drag. Data Type: Real Number Dependency: (None)
SRPArea	Y	Y	m ²	Area used to compute acceleration due to solar radiation pressure. Data Type: Real Number Dependency: (None)
TotalMass	N	Y	kg	Total mass, including fuel mass from attached Fuel Tank resources. Data Type: Real Number Dependency: (None)
OrbitSTM	N	N	(None)	State transition matrix.

				Data Type: Array (6x6) Dependency: Coordinate System
OrbitSTMA	N	N	(None)	Upper-left quadrant of the state transition matrix. Data Type: Array (3x3) Dependency: Coordinate System
OrbitSTMB	N	N	(None)	Upper-right quadrant of the state transition matrix. Data Type: Array (3x3) Dependency: Coordinate System
OrbitSTMC	N	N	(None)	Lower-left quadrant of the state transition matrix. Data Type: Array (3x3) Dependency: Coordinate System
OrbitSTMD	N	N	(None)	Lower-right quadrant of the state transition matrix. Data Type: Array (3x3) Dependency: Coordinate System

FuelTank

Parameter	Writable	Plottable	Units	Description
FuelMass	Y	Y	kg	Mass of fuel in the tank. Data Type: Real Number Dependency: (None)
Volume	Y	Y	m ³	Volume of the tank. GMAT checks to ensure that the input volume of the tank is larger than the calculated volume of fuel loaded in the tank and throws an exception in the case that the calculated fuel volume is larger than the input tank volume. Data Type: Real Number Dependency: (None)
FuelDensity	Y	Y	kg/m ³	Density of the fuel. Data Type: Real Number Dependency: (None)
Pressure	Y	Y	kPa	Pressure in the tank.

				Data Type: Real Number Dependency: (None)
Temperature	Y	Y	°C	Temperature of the fuel and ullage in the tank. GMAT currently assumes ullage and fuel are always at the same temperature. Data Type: Real Number Dependency: (None)
RefTemperature	Y	Y	°C	The temperature of the tank when fuel was loaded. Data Type: Real Number Dependency: (None)

Thruster

Parameter	Writable	Plottable	Units	Description
DutyCycle	Y	Y	(None)	Fraction of time that the thrusters are on during a maneuver. The thrust applied to the spacecraft is scaled by this amount. Note that this scale factor also affects mass flow rate. Data Type: Real Number Dependency: (None)
ThrustScaleFactor	Y	Y	(None)	Scale factor that is multiplied by the thrust vector, for a given thruster, before the thrust vector is added into the total acceleration. Note that the value of this scale factor does not affect the mass flow rate. Data Type: Real Number Dependency: (None)
GravitationalAccel	Y	Y	m/s ²	Value of the gravitational acceleration used for the FuelTank/Thruster calculations. Data Type: Real Number Dependency: (None)
C1	Y	Y	N	Thrust coefficient C_1 . Data Type: Real Number

				Dependency: (None)
C2	Y	Y	N/kPa	Thrust coefficient C_2 . Data Type: Real Number Dependency: (None)
C3	Y	Y	N	Thrust coefficient C_3 . Data Type: Real Number Dependency: (None)
C4	Y	Y	N/kPa	Thrust coefficient C_4 . Data Type: Real Number Dependency: (None)
C5	Y	Y	N/kPa ²	Thrust coefficient C_5 . Data Type: Real Number Dependency: (None)
C6	Y	Y	N/kPa ^{C_7}	Thrust coefficient C_6 . Data Type: Real Number Dependency: (None)
C7	Y	Y	(None)	Thrust coefficient C_7 . Data Type: Real Number Dependency: (None)
C8	Y	Y	N/kPa ^{C_9}	Thrust coefficient C_8 . Data Type: Real Number Dependency: (None)
C9	Y	Y	(None)	Thrust coefficient C_9 . Data Type: Real Number Dependency: (None)
C10	Y	Y	N/kPa ^{C_{11}}	Thrust coefficient C_{10} . Data Type: Real Number Dependency: (None)
C11	Y	Y	(None)	Thrust coefficient C_{11} . Data Type: Real Number Dependency: (None)
C12	Y	Y	N	Thrust coefficient C_{12} . Data Type: Real Number Dependency: (None)

C13	Y	Y	(None)	Thrust coefficient C_{13} . Data Type: Real Number Dependency: (None)
C14	Y	Y	1/kPa	Thrust coefficient C_{14} . Data Type: Real Number Dependency: (None)
C15	Y	Y	(None)	Thrust coefficient C_{15} . Data Type: Real Number Dependency: (None)
C16	Y	Y	1/kPa	Thrust coefficient C_{16} . Data Type: Real Number Dependency: (None)
K1	Y	Y	s	i^{SP} coefficient K_1 . Data Type: Real Number Dependency: (None)
K2	Y	Y	s/kPa	i^{SP} coefficient K_2 . Data Type: Real Number Dependency: (None)
K3	Y	Y	s	i^{SP} coefficient K_3 . Data Type: Real Number Dependency: (None)
K4	Y	Y	s/kPa	i^{SP} coefficient K_4 . Data Type: Real Number Dependency: (None)
K5	Y	Y	s/kPa ²	i^{SP} coefficient K_5 . Data Type: Real Number Dependency: (None)
K6	Y	Y	s/kPa ^{C₇}	i^{SP} coefficient K_6 . Data Type: Real Number Dependency: (None)
K7	Y	Y	(None)	i^{SP} coefficient K_7 . Data Type: Real Number Dependency: (None)

K8	Y	Y	s/kPa ^{C₉}	i ^{SP} coefficient K_8 . Data Type: Real Number Dependency: (None)
K9	Y	Y	(None)	i ^{SP} coefficient K_9 . Data Type: Real Number Dependency: (None)
K10	Y	Y	s/kPa ^{C₁₁}	i ^{SP} coefficient K_{10} . Data Type: Real Number Dependency: (None)
K11	Y	Y	(None)	i ^{SP} coefficient K_{11} . Data Type: Real Number Dependency: (None)
K12	Y	Y	s	i ^{SP} coefficient K_{12} . Data Type: Real Number Dependency: (None)
K13	Y	Y	(None)	i ^{SP} coefficient K_{13} . Data Type: Real Number Dependency: (None)
K14	Y	Y	1/kPa	i ^{SP} coefficient K_{14} . Data Type: Real Number Dependency: (None)
K15	Y	Y	(None)	i ^{SP} coefficient K_{15} . Data Type: Real Number Dependency: (None)
K16	Y	Y	1/kPa	i ^{SP} coefficient K_{16} . Data Type: Real Number Dependency: (None)
ThrustDirection1	Y	Y	(None)	ThrustDirection1, divided by the RSS of the three direction components, forms the x component of the spacecraft thrust vector direction. Data Type: Real Number Dependency: (None)
ThrustDirection2	Y	Y	(None)	ThrustDirection2, divided by the

				<p>RSS of the three direction components, forms the y component of the spacecraft thrust vector direction.</p> <p>Data Type: Real Number Dependency: (None)</p>
ThrustDirection3	Y	Y	(None)	<p>ThrustDirection3, divided by the RSS of the three direction components, forms the z component of the spacecraft thrust vector direction.</p> <p>Data Type: Real Number Dependency: (None)</p>

ImpulsiveBurn

Parameter	Writable	Plottable	Units	Description
Element1	Y	Y	(None)	<p>X-component of the applied impulsive burn (delta-V).</p> <p>Data Type: Real Number Dependency: (None)</p>
Element2	Y	Y	(None)	<p>Y-component of the applied impulsive burn (delta-V).</p> <p>Data Type: Real Number Dependency: (None)</p>
Element3	Y	Y	(None)	<p>Z-component of the applied impulsive burn (delta-V).</p> <p>Data Type: Real Number Dependency: (None)</p>
V	Y	Y	(None)	<p>Deprecated. Velocity component of the applied impulsive burn (delta-V).</p> <p>Data Type: Real Number Dependency: (None)</p>
N	Y	Y	(None)	<p>Deprecated. Normal component of the applied impulsive burn (delta-V).</p> <p>Data Type: Real Number Dependency: (None)</p>
B	Y	Y	(None)	<p>Deprecated. Binormal component of the applied</p>

				impulsive burn (delta-V). Data Type: Real Number Dependency: (None)
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Array, String, Variable

Array, String, and Variable resources are themselves parameters, and can be used as any other parameter would. All of these are writable parameters, though only Variable resources and individual elements of Array resources can be plotted.

Examples

Using parameters in the Mission Sequence:

```

Create Spacecraft aSat
Create Propagator aProp
Create ReportFile aReport

BeginMissionSequence

% propagate for 100 steps
For i=1:100
    Propagate aProp(aSat)
    % write four parameters (one standalone, three coordinate-system-
dependent) to a file
    Report aReport aSat.TAIGregorian aSat.EarthFixed.X aSat.EarthFixed.Y
aSat.EarthFixed.Z
EndFor

```

Using parameters as plot data:

```

Create Spacecraft aSat
Create Propagator aProp

Create XYPlot aPlot
aPlot.XVariable = aSat.TAIModJulian
aPlot.YVariables = {aSat.Earth.Altitude, aSat.Earth.ECC}

BeginMissionSequence

% propagate for 100 steps
For i=1:100
    Propagate aProp(aSat)

```

```
EndFor
```

Using parameters as stopping conditions:

```
Create Spacecraft aSat  
aSat.SMA = 6678
```

```
Create ForceModel anFM  
anFM.Drag.AtmosphereModel = MSISE90
```

```
Create Propagator aProp  
aProp.FM = anFM
```

```
BeginMissionSequence
```

```
Propagate aProp(aSat) {aSat.Earth.Altitude = 100, aSat.ElapsedDays = 365}
```