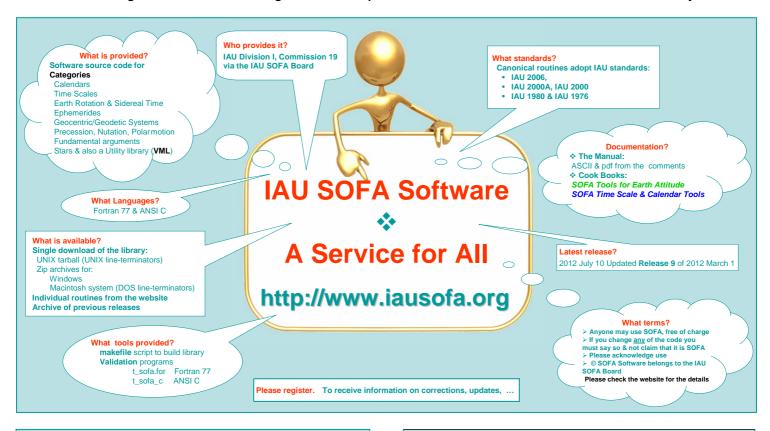


Standards of Fundamental Astronomy



Providing an authoritative set of algorithms that implement standard models used in fundamental astronomy



The SOFA Astronomy Library		
Category	Comments	
Calendars 7 routines	Civil and Julian date conversions. Besselian and Julian epoch conversions	
Time scales: TAI, UTC, UT1, TT, TCG, TDB, TCB, TAI-UTC, TDB-TT 20 routines, 16 canonical	There are 16 routines that link the time scales, plus 2 routines to convert between time and date that caters for more than 59 seconds, the number of leap seconds, i.e. the difference between TAI and UTC, an approximation to TDB-TT.	
Earth rotation & Sidereal time: GMST, GAST, ERA, 15 routines, 10 canonical	Greenwich mean sidereal time (IAU 1982, 2000, 2006). Greenwich (apparent) sidereal time (IAU 1994, 2000A, 2000B, 2006/2000A). Equation of the equinoxes (IAU 1994, 2000A, 2000B 2006/2000A). Equation of the equinoxes "complementary terms" (IAU 2000). Earth rotation angle (IAU 2000).	
Ephemerides 2 routines	Barycentric & heliocentric position & velocity of the Earth (medium precision). Approximate heliocentric position and velocity of planets.	
Fundamental Arguments 14 canonical routines	Fundamental arguments used in the IAU 2000A nutation, taken from the IERS Conventions (2003).	
Geocentric / Geodetic Systems 5 routines, 3 canonical	ms The three standard reference ellipsoids supported are WGS84, GRS80 and	
Stars 8 routines	Conversions between star catalog coordinates & rectangular position & velocity vectors and the ICRS, viz: FK5 & Hipparcos star catalog coordinates Update a star's catalog position due to space motion.	

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	The SOFA Astronomy Library	continued
Category	Comments	
Precession, Nutation and Polar Motion 60 routines, 16 canonical	Frame bias components (IAU 2000) Precession angles ζ, z, θ, (IAU 1976, 2000, 2006) Precession angles including frame bias (IAU 2006) All equinox based precession angles (IAU 2006) Flukushima-Williams precession angles, including frame bias γ, φ, ψ (IAU 2006) Mean obliquity ε (IAU 1980, 2006) Nutation angles Δψ, Δε (IAU 1980, 2000A, 2000B) CIP X, Y and CIO Locator s and s' (IAU 2000A, 2000B, 2006/2000A) Equation of the origins Matrices for frame bias (IAU 2000) precession (IAU 1976, 2000, 2006) nutation (IAU 1980, 2000A, 2000B, 2006/2000A) polar motion matrix given position of the pole Celestial to intermediate C (IAU 1976/1980, 2000A, 2000B, 2006/2000A) Celestial to true equinox of date NPB (IAU 1976/1980, 2000A, 2000B, 2006/2000A) Celestial to terrestrial, classical (IAU 2000A, 2000B, 2006/2000A)	
Vector, Matrix Vector, Matrix Routines	x & Utility Routines – VML (Support Zeroize, initialize to identity, and manipulate a p-vector,	,
37 routines	Rotations about the x, y, or z-axis. Vector algebra; plus, minus, dot (scalar) & cross (vector) products, modulus, normalize, scalar times vector. Products of two matrices & transpose of a matrix, a matrix & vector & conversions between matrices & rotation vectors.	
Spherical / Cartesian Conversions 6 routines	Conversions between the coordinate systems.	
Operations on Angles 12 routines	Conversions between vectors & position angle and sepa Conversions between radians and ° (degrees) ' (arc min radians and h (hours) m (minutes) s (seconds), and day Normalize radians between 0 and 2π and $-\pi$ to $+\pi$.	utes) " (arc seconds),

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