Interrelationships between IAU 2006/2000A SOFA routines

The three diagrams set out SOFA's IAU 2006/2000A routines and the principal routines that each calls; a few frequently-used utility routines, such as FW2M and BPN2XY, are omitted in most cases in order to avoid over-complicating the diagram.

The first line of each box gives the name of the FORTRAN procedure, omitting the iau_ prefix. Those routines classed as "canonical" have their names printed in red. Functions (as opposed to subroutines) are indicated by an equals sign at the start of the third line, preceding the value being returned. The second line lists the input (given) arguments (green), where all dates are given as either TT or UT (i.e. UT1); however, all routines use two argument Julian dates and fraction, either TT or UT1, as indicated. The third and following lines list the output (returned) arguments. All angular quantities are expressed in radians. Usual mathematical symbols have been used to denote the quantities, with matrices given in bold.

Line **Comment**

1. Routine name, red implies canonical routine.
2. Input arguments green, separated by commas. Note; all TT and UT (i.e. UT1) arguments occupy two FORTRAN arguments.
3. Output arguments, separated by commas. In the case of functions, the value returned is preceded by an equals (=) sign.

Quantities Returned by Canonical Routines

1. Precession angles γ, φ, ψ, which include frame bias.
2. Bias, precession, and bias-precession matrices, **B**, **P**, **PB**.
3. Mean obliquity of date, ε_A.
4. Nutation in longitude and obliquity $\Delta\psi$, $\Delta\varepsilon$.
5. Earth rotation angle θ.
6. Greenwich mean sidereal time GMST.
7. Locators of the CIO (s) and TIO (s').
8. Series evaluations for X and Y of the CIP.
9. Fundamental arguments, l, l', F, D, Ω, λ_{Me}, λ_V, λ_E, λ_{Ma}, λ_{Ju}, λ_{Sa}, λ_{Ur}, λ_{Ne}, and p_A from IERS Conventions 2003. None of these routines appear in the charts.
10. Equinox based precession angles; ε_0, ψ_A, ω_A, P_A, Q_A, π_A, Π_A, χ_A, z_A, ζ_A, θ_A, p_A, γ_J, φ_J, ψ_J. Angles are relative to the J2000 dynamical system and thus are without frame bias.

Other Quantities Returned

11. X, Y of CIP calculated using bias, precession and nutation angles, the chosen method that all the SOFA routines, with the sole exception of XY06.
12. Nutation matrix **N**.
13. GCRS to equinox and equator of date; bias, precession and nutation matrix **NPB**.
14. GCRS to Celestial Intermediate Reference System: matrix **C**.
15. Polar motion matrix, including s′ **W**.
16. GCRS to ITRS matrix $\mathbf{Q}^{-1}$.
17. Greenwich apparent sidereal time, GAST.
18. Equation of the equinoxes EE.
19. Equation of the origins EO.
20. Equinox precession angles ζ_B, z_B, θ_B including frame bias.

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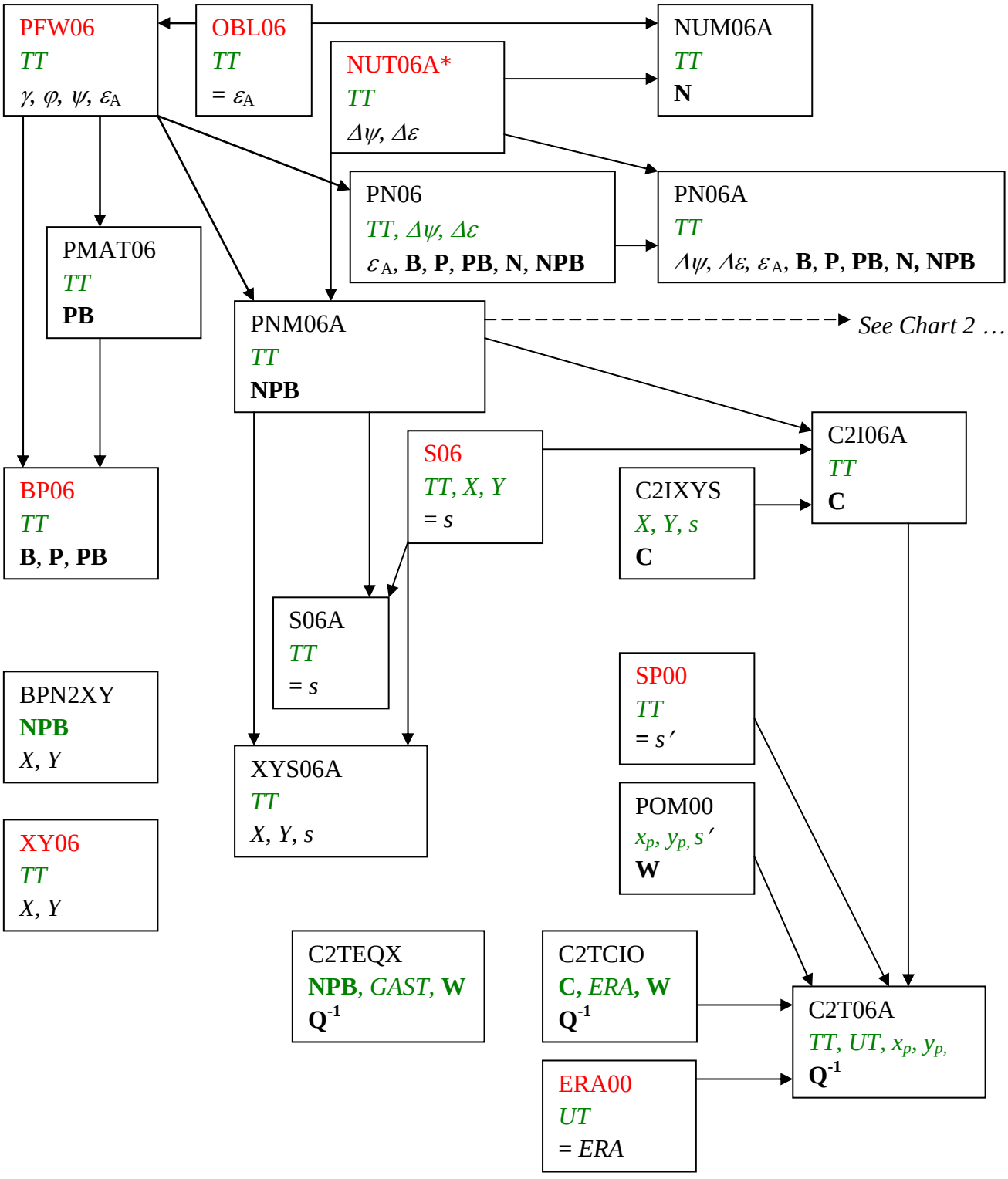
Chart 1: The main routines for transforming from the GCRS to CIRS, TIRS and ITRS.



* Note: NUT06A calls NUT00A.

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Chart 2: Equinox based routines for calculating GAST and related quantities.

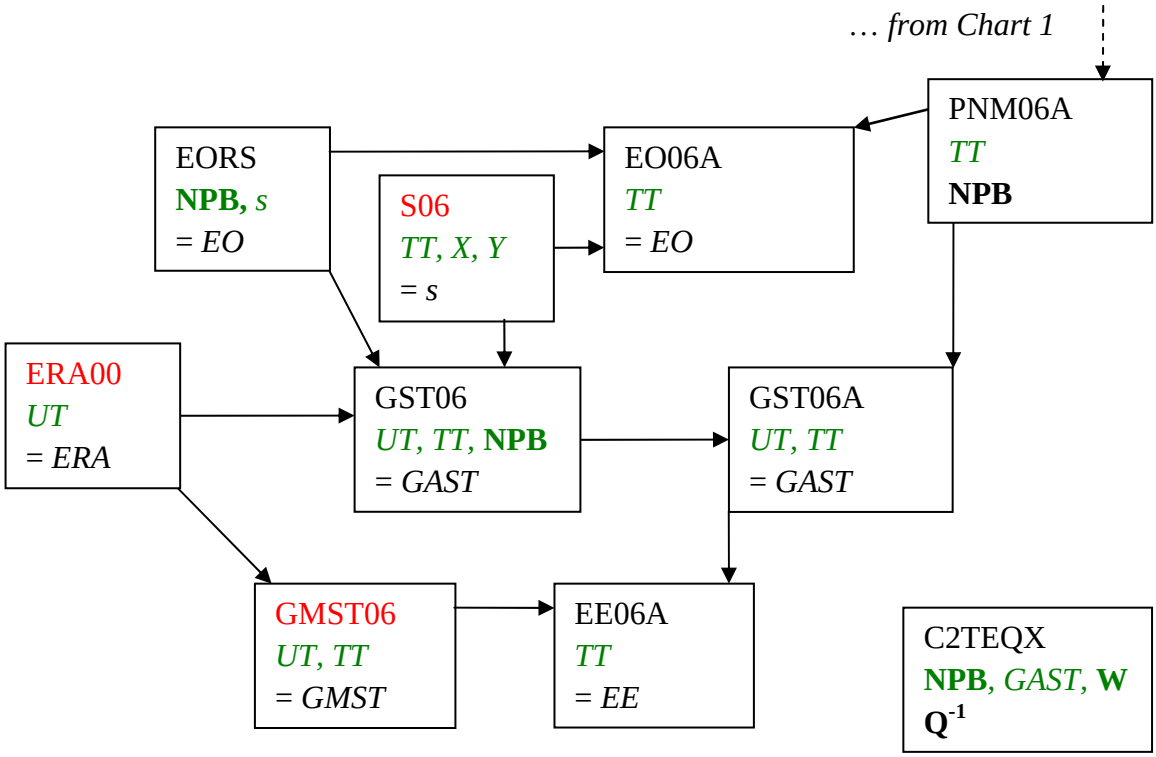
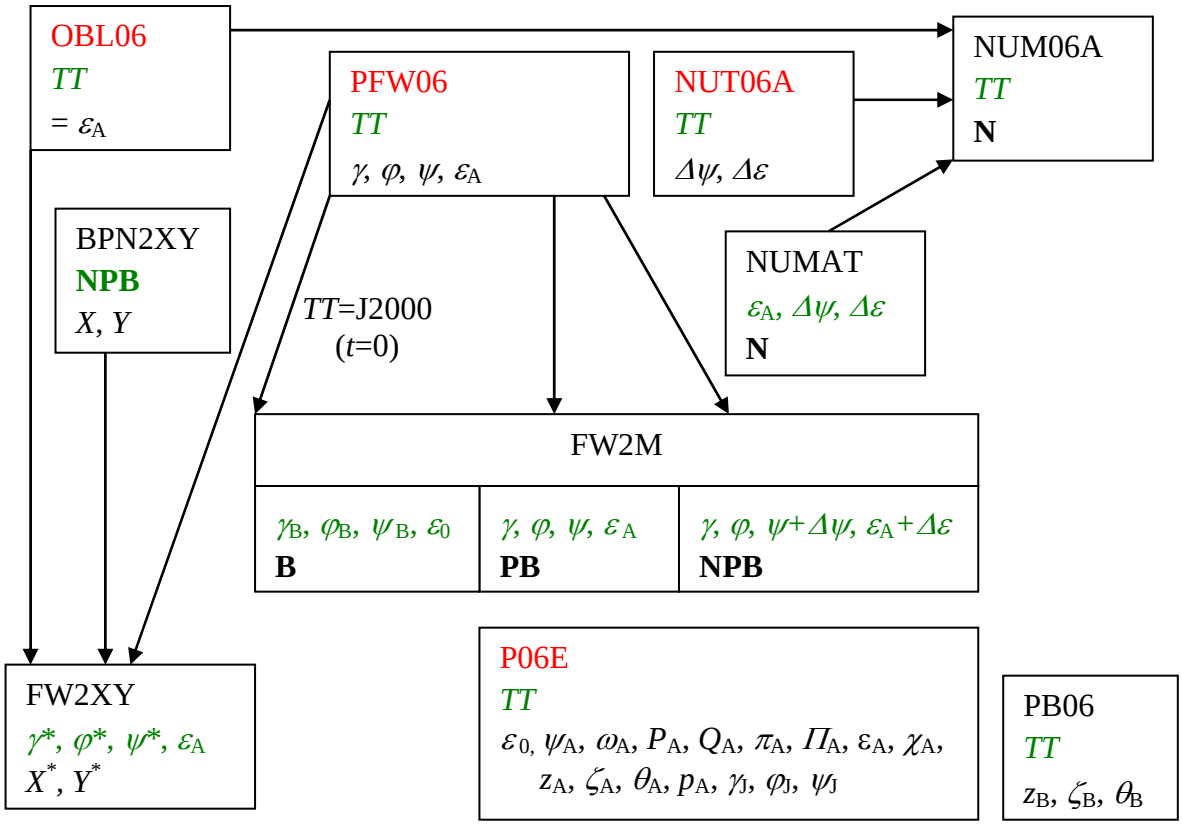


Chart 3: Routines for bias, precession and nutation; not all are shown in Chart 1.



* The arguments supplied by the user may be any of the three sets given for FW2M.

NOTES

CIO based

[ITRS] = **W** $\mathbf{R}_3(\theta)$ **C** [GCRS]

= $\mathbf{Q}^{-1}$[GCRS]

Equinox based

[ITRS] = **W** $\mathbf{R}_3$(GAST **) NPB** [GCRS]

Symbol	Quantity	Rotation from / to	
Equinox based			
B	Bias	ICRS to the mean equator and equinox of J2000.0.	GCRS → J2000
P	Precession	J2000.0 to mean equator and equinox of date.	J2000 → Mean of date
N	Nutation	Mean equator of date to true equator and equinox of date.	Mean of date → True of date (EES)
$\mathbf{R}_3$**(GAST)**	Greenwich apparent sidereal time	True equator and equinox of date to the Terrestrial Intermediate Reference System.	EES (True of date) → TIRS
NPB			GCRS → True of date
CIO based			
C	Bias, precession-nutation	GCRS to Celestial Intermediate Reference System (true equator of date).	GCRS → CIRS
$\mathbf{R}_3(\theta)$	Earth rotation angle	CIRS to the Terrestrial Intermediate Reference System.	CIRS → TIRS
$\mathbf{Q}^{-1}$ **Q**		GCRS to the Terrestrial Intermediate Reference System.	GCRS → ITRS ITRS → GCRS
Terrestrial			
W	Polar motion:	TIRS to the International Terrestrial Reference System; includes $R_3(s')$.	TIRS → ITRS