SOFA's Earth Orientation Routines

- Look at the SOFA website [www.iausofa.org](http://www.iausofa.org)
  Library of routines in Fortran 77 & ANSI C
  Routines are building blocks
- Look at specific routines for:
  - X, Y CIP, s the CIO locator & Earth rotation angle
  - Matrices: CRS to:
    - CIRS, TIRS and the ITRS
- Example programs

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EXAMPLE 1 – Generating matrix $\mathbf{C}$ in a 1-step process

- Using SOFA routines (IAU 2006/2000A) $\mathbf{C}$ may be calculated directly

CALL `iau_C2I06A` (TT1, TT2, C)

- **06** => IAU 2006 + small adjustments
- **A** => IAU 2000A
- TT1, TT2 the required instant expressed as Julian date and fraction, split into two arguments e.g.
  
  TT1 = 2400000D0
  TT2 = MJD

- Run Example

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CIP (X,Y) & ClO Locator (s) & the C2I Matrix C

EXAMPLES 2 & 3: A 2-step process

- **Step 1a**: Series representation for X,Y of CIP
  
  ```
  CALL iau_XY06 ( TT1, TT2, X, Y )
  S = iau_s06( TT1, TT2, X, Y )
  ```

- **Step 1b**: Bias-precession-nutation angle formulation for X,Y
  
  ```
  CALL iau_XYS06A ( TT1, TT2, X, Y, S )
  ```

- **Step 2**: Form matrix with DX, DY from IERS
  
  ```
  CALL iau_C2IXYS ( X+DX, Y+DY, S, C )
  ```

- **Run Examples**

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**Method A** — Generating matrix $Q$ in a 1-step process

- Using SOFA routines (IAU 2006/2000A) $Q$ may be calculated directly

```plaintext
CALL iau_C2T06A ( TT1, TT2, UT1A, UT1B, XP, YP, Q )
```

- **06** => IAU 2006 + small adjustments + **A** => IAU 2000A
- **TT** and
- **UT1** instant required
- **XP, YP** IERS coordinates of CIP wrt ITRS

- **IERS**: $Q^{-1}$ as IERS provide **Terrestrial** => Celestial transformation
ERA, Polar Motion and Matrix Q

Method B: A 2-step process

- **Step 1:** Earth rotation angle
  \[ \text{ERA} = \text{iau\_ERA00} \ (\text{UT1A}, \text{UT1B}) \]

- **Step 2:** Polar motion matrix \((W)\), GCRS \(\rightarrow\) CIRS \(\rightarrow\) ITRS
  \[ \text{SP} = \text{iau\_SP00} \ (\text{TT1}, \text{TT2}) \]
  \[ \text{CALL iau\_POM00} \ (XP, YP, SP, W) \]
  \[ \text{CALL iau\_C2TCIO} \ (C, \text{ERA}, W, Q) \]

- Run Example 4

Needs IERS UT1-UTC

IERS–user supplied

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ERA, Matrix Q (No Polar Motion)

**Method B**: A 2-step process

- **Step 1**: Earth rotation angle
  \[
  \text{ERA} = \text{iau\_ERA00} \quad (\text{UT1A}, \text{UT1B})
  \]

- **Step 2**: GCRS->CIRS (matrix \(C\)) \(\rightarrow\) TIRS (i.e. no polar motion)
  
  \[
  \text{CALL iau\_CR} \quad (\text{C, Q}) \quad ! \quad \text{Copy matrix}
  \]
  \[
  \text{CALL iau\_RZ} \quad (\text{ERA, Q})
  \]
Finally

- Example Fortran and ANSI C programs plus output will be available, also these slides.
- If you have further questions e-mail me Catherine.Hohenkerk@ukho.gov.uk or at sofa@ukho.gov.uk

Thank You