Report to the 20th session of the CCTF from the CCTF WG on Timescale algorithms (WG-Algo)

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Outline of WG-algo (1)

- **Launch:** September 2012 ~.
- **Aims:** *(derived from the Terms of Reference.)*

A) to promote and support the development of mathematical algorithms for a time scale,

B) to help the dissemination of the developed algorithms and tools,

C) to support the modernization and improvement of the TAI algorithm,

D) to assist developing or new laboratories in the correct understanding and implementation of Time and Frequency algorithms,

E) to support the correct understanding and application of time algorithms also in other fields (e.g. navigation, telecommunication),

F) to establish temporary ad-hoc study groups to analyse some specific problems, if necessary;

G) to organize the "Time Scale Algorithm Symposium".

Outline of WG-algo (2)

- **Memberships:** *(derived from the Terms of Reference.)*

  A) representatives of the laboratories contributing to TAI with expertise or interest in algorithms,

  B) the individual responsible for TAI at the BIPM,

  C) the members of the BIPM Time Department devoted to the TAI algorithm, one of them acting as the WG secretary,

  D) members of other organizations or institutions interested in developing and using time algorithms.

  - **Currently, WG-algo consists of 18 members.**

Activities (1)

- **Support to the new TAI algorithm:**
  - The new UTC weighting algorithm was updated after the approval of the WG on the Algorithms.
- **Timescale Symposium**
  - To be discussed in detail in following slides
- **Future improvements for which support may be anticipated:**
  - Generalization of uncertainty computations to accommodate complementary techniques

Activities (2)

- **"VI International Time Scale Algorithm Symposium" :**
  - **Background:**

    1st one in Boulder, CO, USA (1972)
    2nd one in Boulder, CO, USA (1982)
    3rd one in Torino, Italy, (1988)
    4th one in Sevres, France, (2002)
    5th one in San Fernando, Spain, (2008)
    6th one in Sevres, France, (2015)

  - **6th symposium:**
    - Tutorials session (Sep.9) + 2-day symposium (Sep. 10-11).
    - 6 members of SOC are:

      Dr. Patrizia Tavella (INRIM), *Dr. Demetrios N. Matsakis (USNO),*
      Dr. Elisa Felicitas Arias (BIPM), *Dr. Gianna Panfilo (BIPM)*
      Dr. Peter Fisk (NMI), and *Dr. Yuko Hanado (NICT).*

Activities (3)

■ "VI International Time Scale Algorithm Symposium" :

Tutorials session: 9 September 2015

- [Session 1] Time scales:
  - Introduction to timescales (Dr. Matsakis, USNO)
  - Algorithms for the international time scales UTC and UTCr, (Dr. Panfilo, BIPM)
  - National Time Scales (Dr. Rovera, LNE-Syrte)
  - Algorithms for Timekeeping and Space navigation systems (Dr. Tavella, INRIM)
- [Session 2] Basic tools for Time scales:
  - State Space Control (Dr. Koppang, USNO)
  - Applications of Kalman Filters to Time Scales (Dr. Coleman, NRL)
  - Algorithms for GNSS Time Transfer (Dr. Defraigne, ORB)
  - Algorithms to support time transfers by means of digital networks, (Dr. Levine, NIST)

Thanks to the kind allowance of authors and the help of BIPM, the tutorial presentation files have been uploaded on the web-site.

Activities (4)

■ "VI International Time Scale Algorithm Symposium" :

Symposium: 10-11 September 2015

- [Session 1] National Time scales algorithms *(7 talks)*
- [Session 2] Time scale with primary frequency standards *(4 talks)*
- [Session 3] Clock estimation and space systems *(1 Invited & 3 talks)*
- [Session 4] Pulsar time scales *(1 Invited)*
- [Session 5] Anomalous behaviour, correlation, missing data handling *(1 Invited & 6 talks)*
- [Session 6] Kalman and Vondrak applications *(3 talks)*
- [Session 7] NTP algorithms *(1 Invited & 1 talks)*

The presentation files will be uploaded on the web-site if the authors permit.

Activities (5)

- **"VI International Time Scale Algorithm Symposium" :**
  - Summary of the symposium;
    - 8 tutorial lectures
    - 5 invited presentations and 25 contributions
    - 70 registered people, including 4 students
    - from more than 30 different countries.
  - Funding for this symposium and tutorials comes from registration fees and the generous financial support of NICT and ONRG (Office of Naval Research, Global), to whom we are deeply grateful.
- **Formal publication of Proceedings**

  The publication selected papers in a special issue or special section of a prestigious journal is under discussion.