

# THEORY OF ORBIT DETERMINATION SUPPLEMENTARY MATERIAL

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This document contains errata corrigé  
and additional references, with citations  
to be inserted in the Chinese edition.

# Chapter 1

## THE PROBLEM OF ORBIT DETERMINATION

Page 6, line 2 from bottom:  $\boldsymbol{x}$  should be  $\boldsymbol{x}^*$ .

# Chapter 3

## ERROR MODELS

Page 24: the symbol RMS has another interpretation for most authors, what we define here should be better indicated with the symbol STD.

Page 30 second formula:  $\Gamma_{x,y}$  should be  $\Gamma_{(x,y)}$  to avoid confusion with the following formula.

Page 31 line 16: “an invertible  $n \times n$  matrix”

# Chapter 5

## LEAST SQUARES

Page 68 line 6 from bottom:  $-\xi^T B$  should be  $+2/m \xi^T B$

These papers contain additional results on the error models discussed in Section 5.8:

Baer, J., Chesley, S.R. & Milani, A.: Development of an observational error model, *Icarus* **212**, 438-447 (2011)

Chesley, S.R., Baer, J., Monet, D.G.: Treatment of star catalog biases in asteroid astrometric observations, *Icarus* **210**, 158181 (2010)

# Chapter 6

## RANK DEFICIENCY

This paper published in 2010 contains additional material for the relativistic equations of motion of Section 6.6:

Relativistic models for the BepiColombo radioscience experiment, by A. Milani, G. Tommei, D. Vokrouhlicky and E. Latorre, S. Cicalo', in *Relativity in Fundamental Astronomy: Dynamics, Reference Frames, and Data Analysis*, IAU Symposium 261, Klioner, Seidelmann and Soffel eds., Cambridge University Press, pp. 356–365, 2010.

# Chapter 7

## THE IDENTIFICATION PROBLEM

Page 122 line 4:  $\frac{m}{2} \Delta Q$  should be  $m \Delta Q$

This paper contains additional results on attribution, dicussed in section 7.6:

Milani, A., Knezevic, Z. Farnocchia, D., Bernardi, F., Jedicke, R., Denneau, L., Wainscoat, R.J., Burgett, W., Grav, T., Kaiser, N., Magnier, E., Price, P. A : Identification of known objects in Solar System surveys, *Icarus* **220**, 114-123 (2012)

# Chapter 8

## LINKAGE

Page 138 line 5: “the region” should be “the closure of the region”

Fig. 8.7 axis labels missing: should be  $\rho$  and  $\dot{\rho}$

This reference needs to be updated:

Gronchi, G.F., Dimare, L., and Milani, A.: Orbit determination with the two-body integrals, *CMDA* **107/3**, 299-318 (2010)

The following paper contains additional results on the first integrals method described in Section 8.6:

Gronchi, G.F., Farnocchia, D., and Dimare, L.: Orbit determination with the two-body integrals. II, *CMDA* **110/3**, 257-270 (2011)

The following papers contain additional results and practical applications on the space debris problem discussed in Section 8.7:

Farnocchia, D., Tommei, G., Milani, A. and Rossi, A.: Innovative methods of correlation and orbit determination for space debris, *CMDA* **107/1-2**, 169-185 (2010)

Milani, A., Tommei, G., Farnocchia, D., Rossi, A., Schildknecht T. & Jehn, R. Correlation and orbit determination of space objects based on sparse optical data, *MNRAS* **417**, 2094-2103 (2011)

Milani, A., Farnocchia, D., Dimare, L., Rossi, A. & Bernardi, F.: Innovative observing strategy and orbit determination for Low Earth Orbit Space Debris, *PSS* **62**, 10-22 (2012)

# Chapter 9

## METHODS BY LAPLACE AND GAUSS

Page 174 line 5:  $+\ddot{\rho} - \rho\eta^2\hat{\rho}$  should be  $+(\ddot{\rho} - \rho\eta^2)\hat{\rho}$

Page 175: line 19: we use  $\hat{\mathbf{c}}$  for  $\mathbf{c}/|\mathbf{c}|$



# Chapter 11

## SURVEYS

This paper contains additional results on observational selection in surveys:

Gronchi, G.F., Valsecchi, G.B. : On the possible values of the orbit distance between a near-Earth asteroid and the Earth, *MNRAS* **429/3**, 2687-2699 (2013)

# Chapter 12

## IMPACT MONITORING

The following paper contains additional results on the MOID described in Section 12.2:

Gronchi, G.F., Tardioli, C.: The evolution of the orbit distance in the double averaged restricted 3-body problem with crossing singularities, *DCDS-B* **18/5**, 1323-1344 (2013)

This paper contains additional results on impact monitoring, discussed in Section 12.4:

Milani, A., Chesley, S. R., Sansaturio, M. E., Bernardi, F., Valsecchi, G. B., Arratia, O.: Long term impact risk for (101955) 1999*RQ*<sub>36</sub>, *Icarus* **203**, 460-471 (2009)

## Chapter 13

# THE GRAVITY OF A PLANET

Page 283 line 3:  $S_{\ell m} \cos(\psi_{\ell mp})$  should be  $S_{\ell m} \sin(\psi_{\ell mp})$

Page 284 line 12:  $S_{\ell m} \cos(\psi_{\ell mpq})$  should be  $S_{\ell m} \sin(\psi_{\ell mpq})$

Page 284 line 3 from bottom:  $\nu_{lmpq}$  should be  $\nu_{\ell mpq}$

# Chapter 14

## NON-GRAVITATIONAL PERTURBATIONS

Page 291 line 11 from bottom:

$$v_T = \frac{d\mathbf{x}}{dt} \hat{\mathbf{r}}$$

should be

$$v_T = \frac{d\mathbf{x}}{dt} \hat{\mathbf{t}}$$

$$v_R = \frac{d\mathbf{x}}{dt} \hat{\mathbf{t}}$$

should be

$$v_R = \frac{d\mathbf{x}}{dt} \hat{\mathbf{r}}$$

These papers contain recent developments on the determination of non-gravitational perturbations:

A. Milani, Z. Knežević, B. Novaković & A. Cellino: *The dynamics of the Hungaria asteroids*, *Icarus* **207**, 769-794 (2010)

Farnocchia, D.; Chesley, S. R.; Vokrouhlicky, D.; Milani, A.; Spoto, F., Bottke, W.F.: *Near Earth Asteroids with measurable Yarkovsky effect*, *Icarus* **224**, 1-13 (2013)

Farnocchia, D.; Chesley, S. R.; Chodas, P. W.; Micheli, M.; Tholen, D. J.; Milani, A.; Elliott, G. T.; Bernardi, F.: *Yarkovsky-driven impact risk analysis for asteroid (99942) Apophis*, *Icarus* **224**, 192-200 (2013)

# Chapter 16

## SATELLITE GRAVIMETRY

Page 341 line 16:  $\nu_{l_0 p_0}$  should be  $\nu_{\ell_0 p_0}$

# Chapter 17

## ORBITERS AROUND OTHER PLANETS

These papers contain additional material on the BepiColombo Radioscience Experiment:

Milani, A., Tommei, G., Vokrouhlický, D., Latorre, E., Cicalò, S.: Relativistic models for the BepiColombo radioscience experiment. In: Klioner, S., Seidelmann, P.K., Soffel, M. (eds.) *Relativity in Fundamental Astronomy: Dynamics, Reference Frames, and Data Analysis*, IAU Symposium, **261**, 356-365 (2010)

Tommei, G., Milani, A., and Vokrouhlický, D.: Light-time computation for the BepiColombo Radio Science Experiment, *CMDA* **107**, 285-298 (2010)

Alessi, E. M., Cical, S., Milani, A. & Tommei, G.: Desaturation manoeuvres and precise orbit determination for the BepiColombo mission, *MNRAS* **423**, 2270-2278 (2012)

Cicalò, S. & Milani, A.: Determination of the Rotation of Mercury from satellite gravimetry, *MNRAS* **427**, 468-482 (2012)