

Book Review

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Physical Geodesy by Martin Vermeer published by Aalto University Press 2020

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Abstract: The book “*Physical Geodesy*” by Martin Vermeer is written in a proper pedagogic way with a simple and complete text, good examples, conceptual questions and excellent exercises at the end of each chapter. This book is a suitable reference for educational purposes in *Physical Geodesy* from the bachelor to higher levels of education.

Keywords: conceptual questions, educational book, examples in *Physical Geodesy*, review

1 General remarks

1. The text is simple to understand and has good connection with the mathematical formulae and derivations.
2. The book contains nice and self-explanatory figures.
3. One of the interesting points in this book is the application of the Fourier method in different aspects. Also, showing how fast Fourier transform (FFT) should be applied in practice for solving different problems in *Physical Geodesy*, from boundary-value problems to numerical integration of integrals (see also Jekeli 2017).
4. The book contains common parts with other textbooks published in *Physical Geodesy* (Heiskanen and Moritz 1967, Moritz and Hoffmann-Wellenhof 2006) as it should. However, the numerical examples, exercises, some Matlab codes and questions at the end of each chapter make this book rather unique in the subject and suitable for students and teachers of *Physical Geodesy*.

2 Specific remarks

1. Any *Physical Geodesy* book needs to include the basic concepts presented in Chapters 1–7. However, the main point is how to explain them to the readers. Chapter 1 is about the foundations of the potential theory, which are presented from a simple case for a point-mass and developed step by step toward the solid body and Newton’s integral. After that different theorems in field theories are presented and later the boundary-value problems are discussed. Solution of the Laplace equation in rectangular and polar coordinate systems is explained well in Chapter 2, and Chapter 3 comes as a complementary to the former chapter by mathematical discussions about the Legendre functions as well as the spherical and ellipsoidal harmonics. The normal gravity field and anomalous quantities in *Physical Geodesy* are discussed using excellent graphics, simple text and mathematical derivations in Chapters 4 and 5. The Bouguer and isostatic reductions are discussed extremely well with good figures and clear mathematical derivations in Chapter 6. In addition, the theory of the height systems is clearly presented in Chapter 7 with great numerical examples. These seven chapters are suitable for teaching *Physical Geodesy* at the bachelor level.
2. Chapter 8 provides a good review of the Stokes formula modification and integration as well as downward continuations using the gradient method. Integral inversion could also be shortly explained. Application of FFT for numerical integration of the Stokes formula and computing the residual terrain correction are pedagogically explained in Chapter 9. Applying FFT for the modified Stokes’s formula could have also been explained mathematically as well to show a connection with the former chapter.
3. The numerical examples about least-squares collocation in Chapter 10 and exercises are excellent.
4. Discussion about the instruments and gravimeters is good, which can also be used for teaching at the

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bachelor level; interested readers are referred to Torge (1989) for more details. However, adjustment of the gravimetry networks could have been discussed like what Sanso and Sampietro (2022) did. Chapter 12 presents basis of oceanography and its connection to the Earth's gravity field, which is good and applicable, but could be written more practical.

5. Chapter 13 is mainly dedicated to satellite altimetry; the discussion about the cross over adjustment is excellent, but the part related to satellite gravimetry could have been deeper as they have more direct connection with *Physical Geodesy* than satellite altimetry; see e.g. Eshagh (2020) for the different satellite gravimetry observations in terms of the spherical harmonic coefficients of the Earth's gravity field.
6. Chapter 14 starts immediately with the formula of the gravitational potential of the tide. Some explanations or introductory texts could have been provided. The discussion about the corrections due to solid tide is extremely useful, but the ocean tide loading was rather incomplete, which could have been valuable to be explained more.
7. Appendices A, B and E provide good and complete mathematical tools, which are required for understanding and digesting the mathematical concepts discussed in the book. The readers are recommended reading them for understanding the book easier. Appendix C is of more theoretical nature about the Fourier method, and Appendix D even if it has the focus on the Helmert condensation, but it presents nicely how to model the gravitational potential of the topographic masses using spherical harmonic series; see also Eshagh (2020).

3 Conclusion

The book is well-written, and the text is clear and understandable that a reader can follow it without any difficulty. The figures are nicely created with good connection with the text. In short, the book is written for educational purposes, in this reviewer opinion. It discusses all necessary topics, which should be discussed in *Physical Geodesy* with the authors' perspective and experiences. I will use this book as a reference for teaching if I have the opportunity of teaching *Physical Geodesy* at the bachelor level. For higher education levels, depending on syllabi of courses, I use some parts of the book, particularly discussion about satellite altimetry and oceanography, statistical methods and application of the FFT. Currently, I use some parts of this book for giving the *Advanced Physical Geodesy* course to the PhD students of Geodesy at Addis Ababa University.

Conflict of interest: The author states no conflict of interest.

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