Introduction to Special Theory of Relativity

Sukanya Sinha

Introduction to Special Theory of Relativity
Somnath Datta
Allied Publishers Limited
1998, pp. 209.

This is a textbook primarily aimed at undergraduate students, though the last two chapters are geared more towards a post-graduate student or perhaps an undergraduate who wants to go beyond the prescribed curriculum. The first two chapters help to put special relativity in its proper context in terms of its relationship with Newtonian physics on the one hand and with general relativity on the other. In fact, an entire chapter is devoted to Newtonian relativity and it seems well worth it. Chapters 3 and 4 cover the standard material on special relativity for an undergraduate curriculum starting from the postulates of relativity to relativistic mechanics.

In most places, mathematical steps are worked out in clear detail interspersed with small exercises to fill in intermediate steps (to wake up students when they start relying too heavily on the derivations in the book). This makes it a good book for self-study. There are ample number of exercises and problems at the end of each chapter to help a student become more familiar with the mathematical manipulations and their interpretations. However, it would have been more rewarding for the reader if some more problems which go beyond drills and proving identities could be accommo-dated. These could, for example, include problems related to resolving interesting paradoxes and 'real life' examples drawn from various branches of physics and astrophysics. Another shortcoming in my view is the lack of (or rather very limited) use of space-time diagrams. These should be an integral part of relativity teaching at the undergraduate level. Many of the problems and paradoxes described could have been visualized and understood much more compactly and clearly with the use of space-time diagrams.

The penultimate chapter introduces four-vectors and tensors and equips the reader with the mathematics required to manipulate them. The author then goes on to use this machinery to give a covariant treatment of Maxwell's electrodynamics and to introduce and illustrate the covariant stress-energy tensor in various contexts such as fluids. Though Maxwell's equations played a pivotal role in the development of special relativity, a covariant treatment of Maxwell's equations is rarely found in standard undergraduate relativity textbooks. Students often have to wait for a graduate electrodynamics course for their first encounter with it, so it is nice to see it all under one roof in this book. Covariant forms of stress-energy tensors are also seldom encountered before a field theory course (a rare exception is the integrated approach of Landau and Lifschitz). It is a welcome addition to a book at this level and a warm-up exercise for anyone who wants to go on to study general relativity or field theory. At the end, the author has provided a detailed list of references corresponding to every chapter with short reviews of the contents highlighting the strengths where appropriate. This should also prove very useful for selecting supplementary reading material.

In summary, this is a good book to have for an introductory undergraduate course in relativity. Using it, students can lose their fear of four-vectors at an affordable price!

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Mathematics and Sports

Vivek S Borkar

Mathematics and Sports
L E Sadovskii and A L Sadovskii
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One does not usually associate mathematics with sports or vice versa. In fact, the traditional stereotype of a mathematician is a highly nonathletic, myopic individual with his head buried in books. Reality, of course, is otherwise. One finds many who are proficient in both mathematics and sports, but even so, rarely there's someone who combines the two. Mathematics in sports? Certainly Tendulkar does not solve Newton's equations for the approaching ball to calculate the optimal thrust his bat must supply. But then there are two aspects to any competitive sport. There's *skill,* which no amount of mathematics can give you, and there's strategy. It is the latter that can be amenable to mathematics, particularly to the mathematics decision making, otherwise known as operations research. The little book by the Sadovskiis deals precisely with this aspect of mathematics in sports. No better way to explain what that entails than to borrow from the author's own examples.

An early illustration given in the book of the efficacy of mathematics is the board game of Hex, wherein John Nash (of the Nash equilibrium fame) proved that the player who starts will always have a winning strategy. Moving from board games to 'real' sports, the authors go on to describe how a tennis game can be modelled as a Markov chain, allowing us to estimate the probabilities of various outcomes. Among the different issues addressed is the question of 'why five sets?'. Simply put, if the difference in the level of competence of the two players is small, it will be more pronounced in the outcome of the game if the number of sets is larger. Thus it makes sense to have that number as large as possible. Subject to the natural constraints put by fatigue etc., five turns out to be a reasonable solution.

This is followed by an entirely different issue, viz., that of how to optimally combine evaluations of several experts on nonquantifiable outcomes like the quality of performance of a gymnast or a skater. For people like me who have forever been mystified by how these (not to mention beauty contests) get graded through a highly subjective collection of numbers on a scale of 0 to 10, this chapter will clarify many things. The next chapter describes how one can use statistical methodology to predict trends in records that are being set over the years in various athletic events. Thus, for example, Beamon's long jump in 1968 Olympics was dubbed a jump into the next century because he achieved what was expected to happen only in the 21st century. A longish chapter on linear programming follows dealing, not surprisingly, with one of its traditional applications albeit in the context of sports: resource allocation, be it the positioning of players on the field, allotment of players, or planning the players' diet. In the next chapter, real games meet mathematical games. Applications? Well, there are applications to strategic planning in swim teams, ski teams, weight-lifting, etc. that are described, but the place of pride goes to a newsclip about a hockey game where game theoretic planning won the day. The following chapter addresses the problem of how to pair off teams while organizing a competition. Latin squares make their appearance here, and to the Indian readers' delight, the kingpin of the results mentioned involves two Indian names – Bose and Shrikhande. The penultimate chapter is a short account of how the ratings of sportspersons are arrived at, another mystery demystified.

This is just a barebones sketch of the kind of topics covered in the book. There's much more. There is an introduction on the spirit of applied mathematics in general and a concluding chapter on the caution one must exercise in any application thereof to sports. (For example, one must keep in mind that the mathematical formulations only caricature the total reality in rather simplistic terms and therefore can only be aids to intuition, not a substitute for it.) There is also a brief account of other applications at the end. This is not all, the whole book is peppered with tidbits of sports trivia, rules and their ramifications, amusing anecdotes, etc., and many concrete examples that make the book very lively reading.

On the down side, there is an occasional quaint phrase or two, not an uncommon feature in books written and translated by people for whom English is not a native tongue. But one can gloss over such minor irritants in view of the overall charm of the book. I would consider this book as a 'must read' for students of applied mathematics, particularly operations research, as well as those of the many engineering disciplines which have a considerable overlap with it. It does more than just entertain and educate – it presents the basic concepts of operations research in familiar, friendly terms, so that one can immediately 'resonate' with them.

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The Special Theory of Relativity is a theory of classical physics that was developed at the end of the nineteenth century and the beginning of the twentieth century. It changed our understanding of older physical theories such as Newtonian Physics and led to early Quantum Theory and later the Theory of General Relativity. Special Relativity is one of the foundation blocks of physics. Books. An Introduction to Relativity. The special theory of relativity. An Introduction to Relativity. An Introduction to Relativity. Chapter. Chapter.Â As we know, the twentieth century saw the emergence of two theories, fundamental but totally unexpected by the stalwarts of the nineteenth century, viz., relativity and quantum theory. Recommend this book. Email your librarian or administrator to recommend adding this book to your organisation's collection. An Introduction to Relativity. Wave equation, Molecular Field, Dirac special relativity. 2. A. Introduction. For more than a decade we treat molecular systems exposed to external electric fields. Most of the ideas we had about this subject were published in a series of articles starting in 2003.Â Molecular Fields be affected by relativistic mass effects? In order to study this possibility we extend the BOH approach so that it includes the Dirac relativistic theory of the electron! (21-22). B. Comments to the Born-Huang treatment.