

Commentary on: Semon MD. Review of: *Mathematical Methods for Accident Reconstruction*. *J Forensic Sci* 2010;55(4): 1138–9.

Sir,

Writing a book always produces errors and omissions, and the authors welcome any and all corrections. However, after careful review of Mark Semon's comments, we find that the minor errors were mainly because of typos and miscommunication with the publisher. The minor errors do not warrant the scathing comments and trivialization into a 1970s Spaghetti Western. In response to the review of our book, we wish to make a few points. It is obvious that Semon sees himself as the Clint Eastwood character of "The Good, The Bad, and The Ugly." The "Ugly" refers to alleged conceptual errors, the "Bad" refers to typographical errors, and the "Good" accounts for an entire paragraph. His characterization of "The Ugly" will be addressed first.

The "Ugly"

We assume that he stated that our description of "the Second Law is a direct consequence of Newton's First Law" is incorrect because of our choice of the word consequence. Webster defines consequence as a result of an action, process, etc.; outcome, effect, a logical result, or conclusion; inference, the relation of effect, or cause. By the First Law, if a body is at rest or in uniform motion, it remains so unless acted upon by external forces. Consequently, if it is acted upon by external forces, we should apply Second Law principles. He further stated that "because a body free from all external influences moves with constant velocity means that its change in velocity is proportional to the net force acting on it or is inversely proportional to its mass." If the body moves with constant velocity, it does not experience a change in velocity. His statement is therefore ludicrous. If the First Law applies, the body does not have a change in velocity. If the body has a change in velocity, the Second Law applies. Consequently, if the First Law does not apply, we use the Second Law.

In our explanation of the Third Law, we use a body on a table instead of on the ground. In this discussion of the force of gravity, we assume that the reader understands that the opposing force is because of the earth or the objects that rest upon it. For example, we do not use the forces exerted on the body by other solar system objects, such as the moon or Jupiter. We are just lucky that we did not use the word consequence in the explanations relating to the Second and Third Laws, otherwise we would be chastised by the gunslingers. Any rational observer sees the relation between Newton's laws and their interdependence.

The discussion of centripetal acceleration on page 78 is self-evident from the discussion of the curved trajectory on page 77, and we do not feel that it warrants further explanation. Mr. Semon criticizes our description of mass times centripetal acceleration (mv^2/R) as a centripetal or radial force. Because the term mv^2/R is properly being used in a summation of forces in the radial direction, it is not clear why he criticizes our description. Semon also stated that some derivations contain errors. We acknowledge that in equation (11.3), the cosine term should be sine. However, typos do often occur, and the subsequent equations are correct.

The falling cylinder model is based on conservation of energy equating total potential energy to total kinetic energy. In a fall,

generally caused by slipping, there is translation and rotation that produce the total kinetic energy. The translation we are referring to is the movement at the top of the cylinder, which represents the "head" of the falling person. Translation of a person walking in the x -direction can easily be implemented into this derivation. However, unless the falling person impacts a vertical surface, it is unclear how the kinetic energy based on walking speed would have an effect on the derivation. If an object is dropped from a height, the maximum speed it can attain, neglecting air resistance or mysterious outlaw forces, is governed by the square root of $2gl$. Having observed humans falling and conducting tests on cylinders tipping, the speed is somewhat less than the free fall speed. This model takes those effects into consideration. The argument about what the head is doing is simply irrelevant for two reasons: (i) The head does not move significantly, and (ii) We don't know how to quantify it. We would be glad to include the gunslinger's derivation of the problem if he would perform it. In science or engineering when you state that an equation is wrong, you must prove how it is wrong and not simply state that it is wrong.

The "Bad"

In "The Bad," Mr. Semon has found errors that we acknowledge. Some errors he did not find according to his discussion. Errors in books are produced by several factors including globalization, the use of different technical writing programs by the authors and the publishing company, and human error. Globalization means that the authors' manuscripts are sent to a foreign country where the publication takes place. Our choice of writing software is WordPerfect because of its superior mathematical editor. The publisher uses Microsoft Word that in translation produces inadvertent errors and human errors. Some of our corrections on the galley proofs were made, others were not. Specifically, equation (2.14) that incorrectly listed v_o rather than $v_o t$ was corrected in the galley proofs. Somehow, the publishing company did not make this correction. Other errors are our own, including equations (2.77) and (2.88) wherein the term d_s was used instead of ds . This error was not caught during our proofreading.

Mr. Semon lists roughly 17 equations that had typographical errors. By our count, 566 numbered equations are included in the book. There are several unnumbered equations not included in this total. Thus, the maximum error rate is $17/566$, or roughly 3.0%. However, a close examination of Semon's extensive notes reveals errors of his own. He claims that equation (9.4) should have a t_i^2 instead of t_i . Equation (9.4) is written as the following:

$$d_1 = t_i \left(v - m + \frac{1}{2} at_i \right)$$

This equation, as referenced in the preceding paragraph on page 184, is taken directly from the AASHTO *Green Book*. Furthermore, it should be clear that there is a t_i term both inside and outside the parentheses, which results in his desired square term. By this count, our new error rate stands at $16/566$, or roughly 2.8%.

Another criticism made by the reviewer includes a reference to the term Δs on page 77. On page 76, the term s is clearly defined as the average speed (a scalar quantity) equal to the distance traveled (D) divided by a time interval (Δt). As stated in the first sentence of the preface, this book is intended for engineers and scientists who

perform accident reconstruction. Persons with this background should be expected to know that the Δs term represents a “change” in the variable s . Certainly, the emphasis on basic mathematical principles in Chapter 2 should have reinforced this concept.

So, the new error rate should be 15/566, or roughly 2.7%. Given that Mr. Semon was incorrect in two of his 17 corrections, his error rate is 2/17, or roughly 11.8%. We should note that his error rate is relatively small, albeit over four times greater than our own. And his errors do not excuse our own mistakes and oversights, or the errors made in translation (of language, not of a falling cylinder). Such typographical mistakes are very common. In our library, we have a fifth edition of an excellent book on accident reconstruction by an author mentioned in Mr. Semon’s review. The errata sheet included with this fifth edition lists 35 corrections. The majority of these errors are minor, including incorrect subscripts, lack of bolding on vectors, misplaced plus and minus signs, and swapping of variables. Such minor errors are to be expected and do not take away from the quality of that book.

We acknowledge our mistakes and take responsibility for them. Several of Semon’s criticisms are valid and one’s that we share. Specifically, we found that the number of worked examples are lacking. As this book is geared toward engineers and scientists working in the accident reconstruction field, a teaching edition was not a high priority for our first edition. We plan to include these corrections in later editions. We certainly welcome any and all corrections that are valid, and we are certain that there are more errors not found by us or Mr. Semon. We do, however, take offense to unwarranted and incorrect characterization of the spaghetti western rather than a professional review of the book. Keep in mind that no book is perfect and that most contain a multitude of errors.

Finally, there is nothing wrong with using older references. Must all books on accident reconstruction reference the Northwestern University Traffic Institute Manual, which was written more than 20 years ago? There are many other books on accident reconstruction that were not referenced. For which other unused references should we be chastised?

The “Good” and Conclusion

According to the reviewer, the “Good” sections of our book include Chapters 9–13, as a general description of each chapter is

given, and a general statement of their quality is made. The authors would like to disagree with Mr. Semon’s conclusions. Chapters 9–13 are arguably some of the weakest sections of the book. However, the basic concepts in these sections are consistent with and reinforce the other sections deemed “Bad” or “Ugly.”

Mr. Semon stated that because of the multitude of notational and conceptual errors, our book could not be recommended. We have addressed the notational errors, which are primarily typographical in nature, and have shown that our error rate is small. The “conceptual” errors are essentially arguments over semantics and descriptions. A “concept” is usually defined as a general idea derived or inferred from specific instances or occurrences, something formed in the mind, a thought or notion, or a scheme. We find no major concepts presented in our book that are in conflict with basic principles presented in a physics or mathematics textbook. Mistakes in referring to “dissipation of force” rather than “dissipative forces” are acknowledged, yet do not constitute errors in concept. Mr. Semon may not approve of the word “consequence” in describing the relation of Newton’s First and Second Laws, but as we have explained, this critique does not constitute a violation of foundational principles.

The major arguments of our book, regarding basic physical laws and principles that are applicable to the field of accident reconstruction, are not challenged by Mr. Semon. The derivations used to solve these problems are not challenged. The use of equations in specific instances, traditionally a lightning-rod of criticisms in the field (especially the use of momentum principles), is not challenged. Again, the criticisms are almost entirely based on typographical errors and arguments over semantics. Finally, in light of the reviewer’s own errors, Mr. Semon appears to be holding our book to standards he does not hold for himself.

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