

## Writing articles on using computers in physics education

Recently, we have received several submissions that discuss the use of various computer programs for use in physics courses. In many cases we have had to turn down such submissions, not because they were wrong, and not even because they were not useful, but rather because the manuscript contained relatively little of value that was independent of the software. In many cases these manuscripts were mostly an announcement of the software developed by the author. A paper in AJP is not the appropriate place for such an announcement. There are many more appropriate ways to make educational software better known. One possibility is to place the material on the Web and search the Web for other sites that could link to your site. Also, AAPT and a number of other organizations participate in the National Science Digital Library,<sup>1</sup> which has links to educational software. Physics Academic Software publishes education software for the physics teaching community,<sup>2</sup> and the education column in the magazine *Computing in Science and Engineering*<sup>3</sup> regularly has articles on educational uses of software.

Do we mean to suggest that no computer-based manuscripts are appropriate for AJP? Of course not. In order to encourage more articles in AJP involving the use of computers in physics education, I will describe the types of manuscripts that would be appropriate. They generally fall into three categories.

The first category consists of papers that describe a new algorithm (or one that is not well known). There should be enough detail in such a manuscript so that readers could write their own program. The manuscript should not only explain the algorithm, but provide some significant examples of how it will help students learn some new physics. The algorithms might include methods of visualization, animation, numerical analysis, and simulation. Examples in this category are two papers on the numerical integration of Newton's laws<sup>4,5</sup> and a paper introducing the Metropolis algorithm for doing Monte Carlo simulations.<sup>6</sup> Papers in this category are analogous to the experimental papers in the Apparatus and Demonstration Notes section of AJP.

The second category consists of papers that use well known algorithms, but provide significantly new insight into physics. Many of the papers on chaos that have appeared over the years in AJP are in this category. Another example is a paper on a Monte Carlo simulation of gamma ray transport in a medium.<sup>7</sup> For papers of this type the author need only state the algorithm they are using and provide enough detail about the parameters used in the numerical computations so that the reader can reproduce the results discussed in the paper. Usually, knowledge of the specific details of the computer program are not important for understanding the paper and obtaining the insight the author is trying to convey.

The third category consists of papers that report on new algorithms that have been used in research that are accessible to students and the general reader of AJP. In these cases the paper's goal is to describe the algorithm and the interesting physics that can be explored with that algorithm. Because the paper is based on contemporary research, it is frequently the case that the paper will discuss a simple model that will help the reader understand the basic ideas of the computation. Thus, for example, the discussion might center around a two-dimensional model when the actual research involved three dimensions.

We are encouraging papers whose purpose is to make contemporary research accessible to a broader audience of physicists and their students. Computationally oriented papers are particularly appropriate because they are usually easier to understand than highly theoretical papers or manuscripts discussing very expensive experiments that could not be reproduced in an educational context. As an example of the kind of paper we have in mind, we cite a paper on simulations of fluid phase transitions.<sup>8</sup>

Authors who refer to computational methods in their papers should seriously consider putting material on EPAPS.<sup>9</sup> Placing material on EPAPS will ensure that the author's paper will maintain its value for many years. AJP cannot rely on the individual websites of authors.

There are probably other computer oriented papers that might not fit into the above three categories that would still be appropriate for AJP. However, prospective authors should think carefully about what they can convey in a manuscript. All papers should be self-contained to the extent that the reader can learn something significant from the paper without needing to run a computer program.

<sup>1</sup>The National Science Digital Library is at (<http://www.nsdlib.org>). For example, search for physics educational software on this site.

<sup>2</sup>The Web site for Physics Academic software is at (<http://webassign.net/pasnew/>)

<sup>3</sup>See (<http://www.computer.org/cise/>) for more information.

<sup>4</sup>Alan Cromer, "Stable solutions using the Euler approximation," *Am. J. Phys.* **49**, 455–459 (1981).

<sup>5</sup>Ian Gatland, "Numerical integration of Newton's equations including velocity-dependent forces," *Am. J. Phys.* **62**, 259–265 (1994).

<sup>6</sup>D. P. Landau and R. Alben, "Monte Carlo calculations as an aid in teaching statistical mechanics," *Am. J. Phys.* **41**, 394–400 (1973).

<sup>7</sup>F. Arzenos and G. D. Montesinos, "A simple algorithm for the transport of gamma rays in a medium," *Am. J. Phys.* **71**, 38–45 (2003).

<sup>8</sup>Nigel B. Wilding, "Computer simulation of fluid phase transitions," *Am. J. Phys.* **69**, 1147–1155 (2001).

<sup>9</sup>Information on Electronic Physics Auxiliary Publication Service (EPAPS) can be found at (<http://www.aip.org/pubser/epaps.html>)

Jan Tobochnik, *Editor*