Freely Available Optics Lectures and a Proposal for Universal Free Online Education

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Abstract: We describe several entire courses of PowerPoint lectures freely available that are colorful, rigorous, and complete. We propose a grand plan for their extension to other fields, ultimately potentially providing a crowd-sourced free online education.

1. Motivation

All teachers face the same daunting task: preparing knowledgeable, organized, and entertaining lectures day after day. Despite the great technological advances of the past few decades, lecture preparation remains a time-consuming task, performed mostly in isolation with only the possible assistance of a textbook. Worse, the resulting talking head in front of a chalk-filled blackboard continues to fail to inspire students worldwide. Fortunately, technology now allows for the possibility of creating exciting lectures with full-color images, animations, and movies. Such dynamic lectures could compete with the most entertaining non-educational content for students' attention. Unfortunately, creating such lectures is even more time-consuming, with the result that it is rarely done, and PowerPoint lectures are often singularly uninspired and so have a much-deserved bad reputation.

However, once created, high-quality, appealing, exciting PowerPoint lectures can easily be *shared*, significantly reducing preparation time and increasing the excitement of the lecture. The challenge is how to do so without absorbing even more time of teachers.

2. Progress

While various web sites distribute educational applets and images, which is helpful, they only partially solve the problem; these are mere elements of something bigger and much more time-consuming. So, for the past two decades, one of us (RT) has been devoting the considerable time to develop highly polished, full-color, *complete courses* of PowerPoint lectures for four college-level optics and physics courses, complete with pictures, movies, animations, and derivations. They also borrow images and movies from numerous other (appropriately cited) sources. And for the past decade, he has been distributing these entire courses (at www.frog.gatech.edu).

Below (Fig. 1) are still images of several (actually highly animated) slides from these lectures.

These courses are sufficiently self-contained that many report that they have learned these subjects from them alone, *without a lecturer involved*. But their main application has been and will be to allow lecturers to show dynamic lectures that illustrate complex ideas with carefully drawn diagrams and lively animations and movies.

Our recent efforts have been to carefully write scripts for all the lectures and to narrate them. This latter effort remains a work in progress, as the time required to write a script, narrate, and edit the narration is approximately thirty hours per hour of finished narration. This is partially because PowerPoint is not designed for high-quality narration, so the narration process necessarily involves other applications and multiple steps, especially when animations are involved (and they should be). The result is videos of entire courses that students can watch at their leisure (for perhaps a flipped classroom) and or that can be played in class, pausing every few minutes for discussion. Either way, once complete, the resulting effort by the teacher would be minimal, and the results a vast improvement over the traditional chalk-and-talk lecture.

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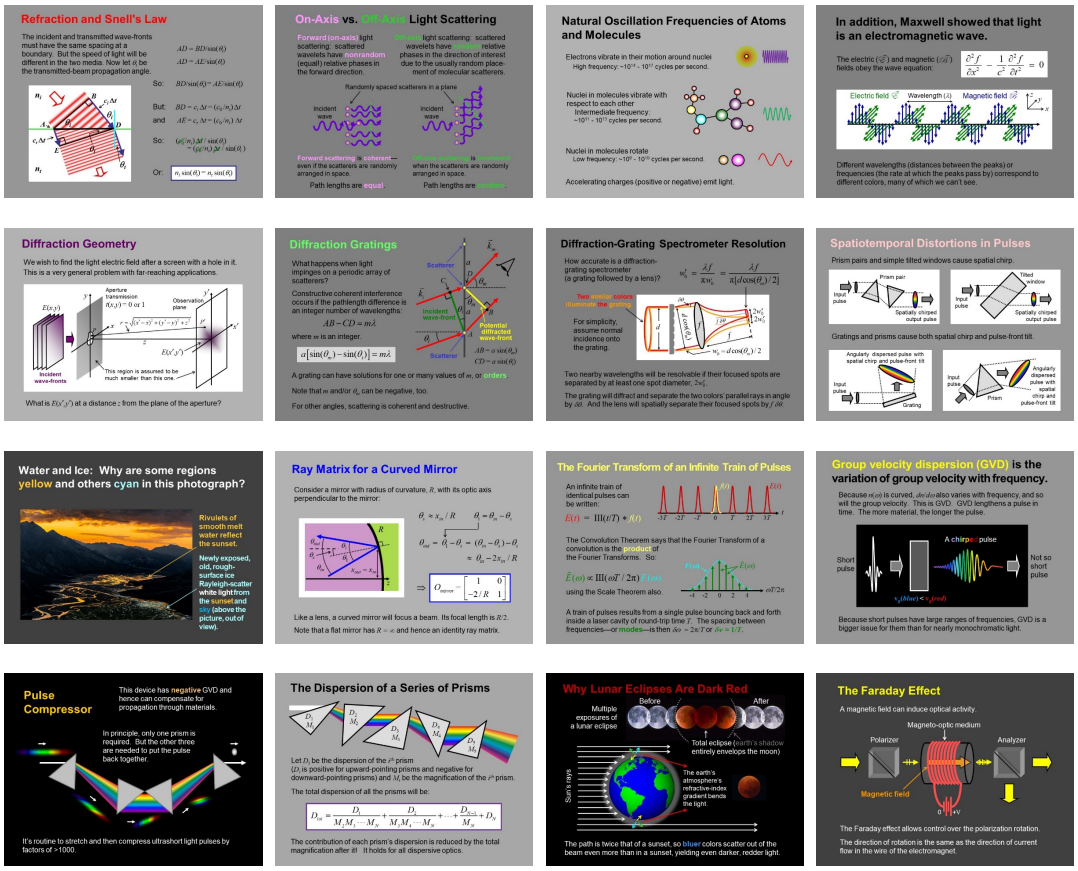

Fig. 1. Sample slides from Rick Trebino's optics course. Reprinted with permission by Rick Trebino (www.frog.gatech.edu).

It should be noted that, while the effort to produce such lectures is quite large (and we have been undertaking it to see how far it can be taken and to produce a sample for others to emulate and improve on), it does *not* require additional investment of funds in software or hardware. As a result, the production of such lectures is an ideal candidate for *crowd-sourcing*. So, we would like to propose extending this approach to *all* subjects and levels, yielding a vast interlinked online educational resource allowing anyone with internet to use for lectures or to self-educate. The effort to accomplish this would be massive—but certainly less than the total effort that is already expended worldwide independently preparing lectures in isolation. It would simply need to be organized.

3. Perspective

A comparison to Wikipedia is helpful. It is arguably the most complete encyclopedia ever produced, benefitting from the altruistic and collective effort of many people around the world. Our proposed effort is analogous but has the additional advantage that it benefits from the fact that teachers are already paid to expend effort in teaching. And students desiring extra credit comprise a vast, previously untapped highly motivated labor pool—one that we have already tapped and that has generated Spanish, French, and Chinese translations of the above-mentioned Optics course.

If Wikipedia has succeeded, perhaps this effort, which offers even greater societal rewards, can also.

4. Results and Recent Progress

The slides for the junior-level Optics course are 100% complete and the narrations for it are ~80% complete, and the slides for the sophomore Modern Physics course are also complete, and their narrations ~70% complete. Additional polishing is also necessary and is in progress. The SPIE has kindly rewarded one of us (RT) for his effort with 2019's Maria J. Yzuel Educator Award and the OSA with its 2019 Beller Medal for Optics Education. With this encouragement, we plan to continue to pursue this effort, also producing, for example, videos on how to produce high-quality narration—information that currently does not appear to be available on the internet.