Report and Recommendations on Available Multimedia Material for Teaching Mechanics at School and University Level

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1. Introduction

There are a number of important reasons that a survey and evaluation of available Multimedia Materials (MM) for physics teaching and learning is both timely and important. A few thousand applets to teach physics are currently available worldwide; approximately ten media servers for MM are in operation; many text books for university physics include MM either on CD or through a publisher's or author's website; and the individual websites of university physics professors contain excellent MM for teaching and learning. One cannot expect most professors in physics (or teachers at a school), mainly involved in research and administration (in pedagogical affairs and administration), to effectively find, evaluate, and use these resources in addition to their duty to teach one or more courses (up to 10 different classes). A systematic approach is needed: to collect available resources, to evaluate this material according to accepted criteria by a board of referees, and to recommend and disseminate the quality material.

At the MPTL workshop in Parma (2002) our members of the former EUPEN-Network (European Physics Education Network) presented an analysis of materials on the topic of Quantum Mechanics for universities [1], and in Prague (2003) we focussed on Optics at both the School and University levels [2]. Recently, three organizations signed a letter of intent to collaborate in this review process: AAPT (American Association of Physics Teachers), EPS (European Physical Society – Educational Division), and MERLOT (Multimedia Educational Resource for Learning and Online Teaching). The work presented here, undertaken in 2004, is a joint effort of the members of the EPS and the MERLOT/Physics Editorial Board, with separate evaluations, more or less in parallel, but in close coordination.

2. Collection of links

Mechanics is an appropriate subject for this study because early MM programs (1970) dealt with mechanical problems (planetary motion, pendulum, collisions etc.)

and because a large fraction of current MM addresses mechanics. It is also timely considering that the American Journal of Physics published a special issue on "Classical Mechanics and Nonlinear Dynamics" [3] in conjunction with a Gordon Research Conference on Mechanics, Dynamics, and Physics Education Research held in Massachusetts from June 13 to 18, 2004.

The *EPS group* created a list of links to approximately 250 multimedia resources (see appendix 1). The task of creating this list was much more difficult than last year's for optics due to the broader range of topics and larger amount of material. We estimate that this list includes only 60-70% of everything available. This number is based on the saturation effect. If the search only leads to material already collected one can be sure to have found the majority of media. The collection of links was obtained through searching the internet and using several relevant databases:

http://kbibmp5.ub.uni-kl.de/
http://didaktik.physik.uni-wuerzburg.de/~pkrahmer/home/mechanik.html
http://miless.uni-essen.de/
http://webphysics.davidson.edu/Applets/Applets.html

The list is structured to follow the presentation of topics in standard physics textbooks. This sorting leads to three problems. The first one is the question of what to include under the title "Mechanics". Here we have created two groups: the first we consider to be the content of "Classical Mechanics", while the second includes "Interdisciplinary Mechanics". Our second problem is the assignment of the media to textbook chapter topics. Very often media could be assigned to different chapters. Approximately 50% of the links can be assigned to more than one topic. The third, related, problem is the breadth of the MM material itself; some of the material deals with an isolated phenomenon, such as friction, while other material covers a whole field like relativity.

The links are distributed as shown in the following table.

Classical mechanics	
mass point mechanics	55
frames of reference and special relativity	24
systems of mass points	13
dynamics of rigid bodies	21
real solids and liquids	32
gases	6
Interdisciplinary mechanics	
flowing liquids and gases	45
mechanical oscillations and waves	30
nonlinear dynamics and chaos	27

While collecting the media we removed some of the links from consideration due to poor quality or because it was only a replication of material already included.

The MERLOT evaluations of Mechanics materials are performed on a collection of links that has been developed over the past 3½ years. MERLOT/Physics is part of a multidisciplinary effort that collects links to multimedia learning materials and helps faculty use these resources through peer reviews, member comments, and examples of use. Any member of MERLOT (membership is free) can add materials to this

collection, although roughly 75% of the items in the physics collection have been submitted by board members or students working with them. Most come from web searches performed by graduate students and post-doctoral researchers.

The MERLOT/Physics editorial board sorts materials into relatively small and specific topical categories to help users find materials for their specific educational needs. Similar to the approach taken by the EPS, the MERLOT topic categories follow closely those found in standard physics textbooks and courses. These categories are maintained such that there are fewer than about 75 items in each. When categories become too large, they are divided and the items re-categorized. Large web sites with many resources, particularly sites covering many topics, are entered into the MERLOT database in pieces. Most MERLOT items are single or small groups of applets, web pages, and/or multimedia presentations covering only one or two topics. Materials that cover more than one topic are categorized in each. Additional information about items such as their resource type (simulations, student activities, tutorials, lecture/demonstration resources, etc.) and their grade level are also provided on MERLOT.

The MERLOT/Physics collection contains approximately 1600 items. The number of items in the classical and interdisciplinary mechanics areas considered in this work, along with the MERLOT topical categories, is listed in the following table.

Topic	***Resources***
1D Kinematics	47
2D Kinematics	26
Projectile Motion	30
Reference Frames	9
Forces & Dynamics	79
Pulleys and Atwood Machines	8
Gravity	26
Energy & Momentum	58
Angular Momentum & Torques	51
Statics (Rigid bodies)	12
Relativity	23
Oscillators (Harmonic Motion)	33
Pendulum Motion	38
Waves (Mechanical)	71
Chaos	6
Fluids	50
Brownian Motion	11
Kinetic Theory of Gasses	9

Links to resources for all physics topics, along with posted reviews, can be found at: http://www.merlot.org/Home.po?discipline=Physics.

Although this topic list is somewhat different than that used by the EPS, the relations are obvious. Some of the differences between the EPS and MERLOT resource lists arise from the break-up of large sites and entry of single applets into MERLOT. Each group included in their analysis lists of resources not used by the other, but about half of the largest sites, with 10 or more items, were listed in both. Of the larger web sites that were not included in both resource lists, several of the MERLOT-only sites

are from U.S. high schools, and several of the EPS-only sites are European. This independent discovery process is very useful for creating a broader list of resources.

3. Evaluation procedures

The EPS and MERLOT/Physics have compared evaluations from previous efforts. There has been a great deal of overlap, i.e. 80-90% of the EPS recommended MM material in Quantum Mechanics and Optics was rated highly by the MERLOT/Physics editorial group.

Below we describe in detail the two different procedures used for evaluating mechanics material by the two groups. In the future, we will develop methods to combine these efforts for greater efficiency.

The *EPS group* followed a list of evaluation criteria that was accepted by all participants of the MPTL workshops in Parma and Prague and has been published [5]. The 250 links were distributed among the 5 members of the EPS group. More than one person evaluated each MM product. In a first quick review, all links were checked in a quick yes/no manner: Does it work? Is it of interest? Is it of sufficient quality? Is it correct? In a second step of the review, each item identified as **good** was re-evaluated, applying a rubric form based on the evaluation criteria mentioned above and given in appendix 2. Since the form contains a simple rating scale with each criterion (++ = 2 points, + = 1 point, 0 = 0 points, - = -1 point, -- = -2 points), it would be possible to rank all the 250 products (although we did not yet do this). In a third step of the review, each member of the review group recommended **excellent** material in terms of what the EPS group considers to be good for teaching and learning. The TOP TEN products have been selected. We have also used these results to try to comment on issues we found for the production of MM material.

The MERLOT Peer Review process is used by many (currently 14) disciplines and the process, rubrics, and results are important products of the MERLOT project. Peer reviews are posted with items on the MERLOT web site. The posting of reviews, unlike research journals, influences their form somewhat; they are written to help faculty more effectively choose and use materials in their courses.

MERLOT peer reviews are based on three main criterion categories: the **Quality** of the material, the **Potential Effectiveness** of the material for enhancing learning, and the **Ease of Use** of the material for students and teachers. Within each of the categories, there are criteria as to what constitutes excellent material. For example: the Quality criteria include the scientific accuracy, importance to the discipline, and effective use of multimedia; the Potential Effectiveness criteria includes the student directed nature of the material, the interactivity of the material and its promotion of student-student and student-teacher interaction, and the quantity and quality of the feedback; the Ease of Use criteria include the simplicity or intuitive nature of the interface, the inclusion of help in using the material, and the listing of bugs or potential problems in using the material. The general peer review guidelines for MERLOT are available online [6]. The MERLOT project has also developed an online review system to enter reviews for items [7]. This helps increase the consistency of the review process and maintains the review history for later reference and study.

Although MERLOT has developed a standard review rubric, each discipline has the flexibility to tailor their review process to meet their specific needs. The MERLOT/Physics editorial board has created standards that reflect the material and interest in physics [8]. Reviews are performed in four main steps. All materials submitted to the MERLOT/Physics collection are viewed by a member of the Editorial Board and sorted into four groups: high priority for review, low priority for review, do not review but leave in the collection, and remove from the collection. From the results of this initial sorting, editorial board members select items for review. Each item is reviewed by two reviewers, editorial board members and/or volunteer peer reviewers. The results of these reviews are then combined into a single composite review. Next, the MERLOT/Physics editor checks the review and sends it to the author for consideration. Because the reviews are being posted, and many of the items are not submitted by the author, this gives a chance for the author to approve the review, respond to the review, or stop the review. If desired, the author can include a response in the review itself. Once approved, or if the author does not respond, the reviews are posted on MERLOT.

4. General comments

In the following we summarize our impressions. These statements should be considered as positive, constructive criticism.

Several of the statements, made for optics (see [2]), are also valid here;

- Many sites collect material from other sources.
- 80-90% of the material is about standard topics (e.g. pendulum and ballistic motion). These standard problems can be found multiple times.
- So far, only English material has been evaluated; the inclusion of other languages should be considered.
- All sites can be accessed and work without problems. The navigation is generally better than during our optics evaluations. To use some material, one has to register for some period of free trial or authorization (and payment) is required. Some sites have a well thought-out navigation system, while most are merely practical. In cases where navigation is difficult, it is impossible to navigate back to a table of contents or to an introductory page.
- Overall the multimedia elements are of good quality and there are only a few poorly realized examples.
- The multimedia types are mostly interactive, with a few non-interactive simulations. There are few videos of real experiments. Often interactivity is limited to setting starting parameters or selecting screen sectors to be magnified.
- Many sites are devoted to one, short and typical physical problem. A few consist of a larger collection of material. One would certainly prefer systematic collections of certain classes of related problems presented in a unique style.
- Many sites contain only mathematics covering whole topics such as ideal point masses or applets with no explanation. In many cases, the mathematical background is not described at all. About half of the simulations contain information about the physical background.
- Suggestions on how to implement the material into teaching/learning are very rare. Didactic reflections are missing for almost all products. Considerations of how to best use the material, such as self studying, teaching, or in lab courses, are missing.

- Some of the best sites are those which require (paid) membership.
- Although there are not any really bad sites, there are not any really good ones either in classical mechanics.
- A considerable fraction of MM material in mechanics deals with simple problems, which can be easily demonstrated in a lecture or in class. Therefore we find it questionable whether it has much pedagogical value to show such things without connecting it with any kind of interactivity, problem solving etc.
- In certain parts of classical mechanics that are conceptually difficult and not easily demonstrated in reality, such as reference frames and relativity, multimedia can be the only tool to visualize important concepts. In such cases solutions via MM are vital.
- The amount of similar materials, in many cases where new materials do not contain any positive additions, indicates the need for better means of finding and sharing these MM resources. This will enable authors and developers to concentrate more on extending existing topics or resources, or to explore topics that are not yet reliably covered.
- Commercial material (e.g. CDs belonging to textbooks) was not included in this evaluation, but will be considered for future reports.

5. Recommended internet websites

Mass point mechanics:

- http://www.explorelearning.com (also real solids)
  Explore Learning is a paid subscription-based site with interactive simulations (called Gizmos) in math and science for teachers and students, mostly at the high-school level. Layout and overall design are excellent, and there is ample help online. A 30-day free trial is available. The site has received several awards. Topics include collisions in one or two dimensions, harmonic motion, parabolic motion, and free fall.
- http://fernstudium-physik.de/medienserver/html/
  The Medien Server from the Universität Kaiserslautern contains university-level multimedia for use in classroom or distance learning. Mostly German and mostly restricted access (limited to registered students), although some are free. Quality is generally excellent, and MM is easy to use, although online help or documentation is limited. Some very good short video-clips and mostly non-standard material (relativity).

Frames of reference and special relativity / system of mass points / dynamics of rigid bodies

- http://www.ifm.liu.se/~freka/particleworld/
  Particle World, by Fredrik Karlsson, enables one to create applets in order to perform an almost arbitrary virtual experiment with a system of point masses moving in two dimensions. It is comprehensive, besides predefined situations allows one to build up several situations with springs, gravity, charges, and friction. A unique and very democratic feature of the site is that it allows users to add new systems to study, and provides the necessary tools for such a development. The collection of the contributions from others (as acknowledged authors) is also open for everyone connecting to the site.
- http://www.phy.ntnu.edu.tw/ntnujava
  The Virtual Physics Laboratory, by Fu-Kwun Hwang, is a rather large but not a systematic collection of applets from several parts of physics, including topics

from mechanics. The material is sufficiently advanced, technically good and interactive to a certain extent. Some of the pages provide a concise explanation.

Flowing liquids and gases / mech. oscillation and waves

- http://www.grc.nasa.gov/www/K-12/aerores.htm
  "Aeronautics Resources", from the NASA Glenn Research Center, includes program versions for less and more advanced students. Many Applets can be downloaded and used out of Internet. In the part about Rockets and Kites there are Teacher's Guide and Lesson Plans.
- http://www.falstad.com/mathphysics.html
  The Math and Physics applets page, by Paul Falstad, includes applets on "Oscillations and Waves" and "Acoustics". The page contains Applets with links to relevant physics. The material is at university level only, very useful for the presentation during lectures. All Applets, interactive with many parameters to change, deal with more ambitious physics than the other pages on the topic.

Nonlinear dynamics and chaos

- http://www.sekine-lab.ei.tuat.ac.jp/~kanamaru/Chaos/e/
  The site to be recommended by us is "Introduction to Chaos and Nonlinear Dynamics" by Takashi Kanamaru and J. Michael T. Thompson.
  Additionally to some further material concerning chaos and nonlinear dynamics it consist of a collection of over 20 Java-applets. To every applet there exists a text that explains what it shows, the mathematical background as well as a short instruction of what to do.

MERLOT recommendations (Highly rated materials not listed above, although many were recognized as quality items by the EPS reviewers.)

- http://rlgreene.org
  Physics Illuminations is an online drill and tutorial program for kinematics, dynamics, and vector algebra developed by Ron Greene. Designed to provide students with conceptual physics instruction and practice outside of class, the materials include tutorials illustrated with animated java examples and graded practice quizzes with results recorded for the instructor.
- http://monet.physik.unibas.ch/~elmer/pendulum/index.html
  The Pendulum lab by Franz-Josef Elmer is an extremely thorough investigation of the dynamics of a pendulum, from the simple pendulum to the chaotic motion of the damped, driven pendulum. Virtual experiments can be performed, and an extensive set of hyperlinked notes explains the theory of the system. This material can be used for a wide range of student levels.
- http://hyperphysics.phy-astr.gsu.edu/hbase/hph.html
  HyperPhysics by Carl R. Nave is an extensive outline of physics, from classical mechanics through quantum and modern physics topics. Although this site does not use multimedia extensively, it's creative, deep, and well organized use of hyperlinks makes it a powerful learning tool for introductory and intermediate physics students.
- http://webphysics.davidson.edu/Applets/Applets.html
  Physlets, from Wolfgang Christian and co-workers, is an extensive collection of java applets for simulating physical systems. The power of these tools comes from the ease with which they can be scripted to simulate a wide range systems and the ability of the applets to share data. A single applet, Animator,

along with graphing and data table tools, can be used to cover most of classical mechanics.

6. Conclusion and future aspects

Several results and conclusions arise from this work. First and most important, independent reviews of MM learning materials agreed in identifying high quality items. This indicates a general consensus among experienced teachers about what is useful for teaching and learning, even where review rubrics and methods vary. Second, in the cases of second tier materials where there is a disagreement between reviews, the difference usually depends on the detail of the review. Problems often arise in the details or supplemental materials that are found only through the scrutiny of multiple reviewers. Multiple, independent reviews are crucial for an effective review process. Third, the large number of MM items for mechanics courses, many covering very similar materials in similar ways, indicates the great need for methods of disseminating this work around the world. Reducing this repetition of effort will require two coordinated efforts. Users and authors need tools for sharing and discussing resources so that better and broader material can be developed, and resources need to be designed for reusability by different teachers in different contexts. Emerging international standards on usability should be emphasized [9]. Finally, it is important to note that the reviews performed here can not replace careful assessment studies of the learning potential of objects. Scientific learning assessment is vital, but the goals of reviews and assessments are different. Good assessment is a careful study that takes a great deal of time. Reviews are recommendations from experienced teachers for a wide range of resource types and topics. The reviews performed here are not a scientific assessment just as peer reviews of scientific works do not require a repeat of the research. However, reviews should make use of the results of learning assessments, and assessed materials should receive high priority for review.

The next goal in this effort is to more closely coordinate the work of the EPS group and MERLOT in another survey of a specific physics topic. For this work, the MERLOT collection and the MM servers surveyed by the EPS will be used to build a comprehensive list of items. Both the EPS and MERLOT teams will perform initial evaluations and reviews from this list, with independent reviews performed by each group and a consensus review created for the highest quality items. Members of the MERLOT/Physics editorial board will then format these for processing and posting on the MERLOT site for use by the entire physics community. We will also use contacts with authors of MM learning materials to suggest areas of need.

We suggest that Thermodynamics and Statistical Physics be the next topic reviewed.

Finally, there is a need for a MERLOT-like resource collection for use by the European physics community. MERLOT and the AAPT will continue to support the development of such a collection, and will work to create close ties between such a project, MERLOT, and the AAPT's ComPADRE. We will work to share resources and tools wherever possible to enhance all of these projects, and better support the use of technology in the teaching and learning of physics.

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References

[1] M. Benedict, E. Debowska, H. J. Jodl, L. Mathelitsch, R. Sporken, "Reccomendations (for material on quantum mechanics and for evaluation criteria)", 7th Workshop on Multimedia in Physics Teaching and Learning of the European Physical Society – Proceedings, http://informando.infm.it/MPTL/proceedings/WG5_rec1.PDF

[2] M. Benedict, E. Debowska, H. J. Jodl, L. Mathelitsch, R. Sporken, "Report and Recommendations on Available Multimedia Material for Teaching Optics at School and at University Level", 8th Workshop on Multimedia in Physics Teaching and Learning of the European Physical Society – Proceedings, http://lucy.troja.mff.cuni.cz/~tichy/MPTL/contributions/jodl/report_and_recommendations_for_teaching_optics_prag03.pdf

[3] Theme issue "Classical mechanics and Nonlinear Dynamics", American Journal of Physics 72,4 (2004)

[4] MERLOT is available online at http://www.merlot.org. More information about the project is available online at http://taste.merlot.org.

[5] S. Altherr, A. Wagner, B. Eckert, H. J. Jodl, „Multimedia material for teaching physics (search, evaluation and examples)", European Journal of Physics 25 (2004)

[6] Available online at http://taste.merlot.org/projects/peer_review/criteria.php.

[7] A tutorial for the online peer review workflow tools used in MERLOT is available online at http://physics.ou.edu/~mason/workflow.

[8] More information about the MERLOT/Physics review process is available online at http://physics.ou.edu/~mason/reviewers/index.html.

[9] Available online at http://www.adlnet.org/index.cfm?fuseaction=scormabt

Appendix 1

List of links (EPS)

Mechanics

mass point mechanics

http://www.msu.edu/user/brechtjo/physics/netForce/netForce.html
http://www.msu.edu/user/brechtjo/physics/cannon/cannon.html
http://www.physik.uni-augsburg.de/did/physlets/mechanik/Kepler_jre31.htm
http://www.physik.uni-augsburg.de/did/physlets/mechanik/Schiff_jre31.html
http://www.physik.uni-augsburg.de/did/physlets/mechanik/Flugzeug_jre31.html
http://www.physik.uni-augsburg.de/did/physlets/mechanik/Affe_tot_jre31.html
http://www.physik.uni-augsburg.de/did/physlets/mechanik/Wurf.html
http://www.phys.virginia.edu/classes/109N/more_stuff/Applets/ProjectileMotion/jarapplet.html
http://lectureonline.cl.msu.edu/~mmp/kap2/cd028a.htm
http://lectureonline.cl.msu.edu/~mmp/kap4/cd082.htm
http://lectureonline.cl.msu.edu/~mmp/kap4/cd097a.htm
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=36
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=25
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=42
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=27
http://www.phys.virginia.edu/classes/109N/more_stuff/Applets/newt/newtmtn.html
http://www-spof.gsfc.nasa.gov/stargaze/Sintro.htm
http://zebu.uoregon.edu/textbook/planets.html
http://surendranath.tripod.com/Kepler/KeplersLaws.html
http://surendranath.tripod.com/Kepler/Keplers3Law.html
http://observe.arc.nasa.gov/nasa/education/reference/orbits/orbits.html
http://lectureonline.cl.msu.edu/~mmp/kap7/orbiter/orbit.htm
http://www.byui.edu/insttech/flash1/raw_flash/flashfiles.htm
http://www.schulphysik.de/java/physlet/applets/pendel2.html
http://www.schulphysik.de/java/physlet/applets/fall1.html
http://www.schulphysik.de/java/physlet/applets/ball1.html
http://www.schulphysik.de/java/physlet/applets/pendel1.html
http://www.schulphysik.de/java/physlet/applets/drehpendel.html
http://www.schulphysik.de/java/physlet/applets/zentralkraft.html
http://didaktik.physik.uni-wuerzburg.de/~pkrahmer/ntnujava/projectile3/projectile3.html
http://jersey.uoregon.edu/vlab/Cannon/index.html
http://physicsstudio.indstate.edu/java/newtmech/m_cont_h.html
http://mediamogul.seas.upenn.edu/physics_lab/computerlab.html
http://electron6.phys.utk.edu/video/
http://thorin.adnc.com/~topquark/fun/JAVA/trajplot/trajplot.html
http://thorin.adnc.com/~topquark/fun/JAVA/Kepler/Kepler.html
http://thorin.adnc.com/~topquark/fun/JAVA/pendulum/pendulum.html
http://thorin.adnc.com/~topquark/fun/JAVA/pendchao/pendchao.html
http://www.fernstudium-physik.de/medienserver/html/cgi/omsquery_cgi.exe?subject=Mechanik+eines+Massenpunktes&subsubject=&type=&search=&query=Suche+starten%21
http://www.phy.ntnu.edu.tw/java/xva/xva.html
http://www.phy.ntnu.edu.tw/java/projectile/projectile.html
http://www.phy.ntnu.edu.tw/java/bouncingBall/bouncingBall.html
http://www.phy.ntnu.edu.tw/java/equalArea/equalArea.html
http://pen.physik.uni-kl.de/physlets/animator4/kinematics8_1_3.html
http://pen.physik.uni-kl.de/physlets/animator4/kinematics8_1_4.html
http://pen.physik.uni-kl.de/physlets/animator4/kinematics8_1_7.html
http://pen.physik.uni-kl.de/physlets/animator4/kinematics_1.html
http://pen.physik.uni-kl.de/physlets/animator4/kinematics_2.html
http://pen.physik.uni-kl.de/physlets/animator4/mechanics7_1_1.html
http://pen.physik.uni-kl.de/physlets/animator4/kinematics8_1_5.html
http://pen.physik.uni-kl.de/physlets/animator4/mechanics7_1_3.html
http://pen.physik.uni-kl.de/physlets/animator4/mechanics7_1_2.html

http://pen.physik.uni-kl.de/physlets/animator4/rotations_4.html

frames of reference and special relativity

http://www.openteach.com/astronomy/reltime.html
http://casa.colorado.edu/~ajsh/sr/sr.shtml
http://www.itp.uni-hannover.de/~dragon/stonehenge/stone1.htm
http://www.fourmilab.ch/cship/cship.html
http://www.mathe-online.at/galerie/struct/struct.html
http://www.walter-fendt.de/zd/
http://physics.rug.ac.be/fysica/Relativiteit/Default.htm
http://www.schulphysik.de/java/physlet/applets/relativ1.html
http://pen.physik.uni-kl.de/medien/MM_Videos/index.html (see 'Download', 8 videos)
http://www.fernstudium-physik.de/medienserver/html/index.html (12 videos, applets and interactive screen experiments)
http://www.walter-fendt.de/ph14e/carousel.htm
http://www.phy.ntnu.edu.tw/java/circularMotion/circular3D_e.html
http://thorin.adnc.com/~topquark/fun/applets.html ('Coriolis and centrifugal forces')
http://physik1.physik.uni-heidelberg.de/vrlsg/start.htm
http://www.physicsdemos.com/ (commercial Video Encyclopedia, about 30 videos)
http://www.iwf.de (search 'Higatsberger: Physik in 700 Experimenten' - about 20 videos, 1977)
http://groups.physics.umn.edu/demo/ (see 'Moving in two dimensions', 'Relative motion', 'Newton's Second Law')
http://thorin.adnc.com/~topquark/fun/JAVA/coriolis/coriolis.html
http://www.fernstudium-physik.de/medienserver/html/cgi/omsquery_cgi.exe?subject=Bewegte+Bezugssysteme+und+spezielle+Relativitaetstheorie&subsubject=&type=&search=&query=Suche+starten%21
http://www.phy.ntnu.edu.tw/java/relativeVelocity/relativeVelocity.html
http://pen.physik.uni-kl.de/physlets/animator4/advanced7_3_8.html
http://pen.physik.uni-kl.de/physlets/animator4/advanced7_3_2.html

systems of mass points

http://www.msu.edu/user/brechtjo/physics/airTrack/airTrack.html
http://www.msu.edu/user/brechtjo/physics/airTable/airTable.html
http://www.msu.edu/user/brechtjo/physics/newtonBalls/newtonBalls.html
http://www.ifm.liu.se/~freka/particleworld/
http://www.phys.virginia.edu/classes/109N/more_stuff/Applets/Collision/jarapplet.html
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=10
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=12
http://www.geocities.com/CapeCanaveral/4310/beweg.htm
http://jersey.uoregon.edu/vlab/Momentum/index.html
http://thorin.adnc.com/~topquark/fun/JAVA/coupled/coupled.html
http://www.phy.ntnu.edu.tw/java/projectileOrbit/projectileOrbit.html
http://www.phy.ntnu.edu.tw/java/Kepler/Kepler.html
http://www.phy.ntnu.edu.tw/java/circularMotion/circular3D_e.html

dynamics of rigid bodies

http://lectureonline.cl.msu.edu/~mmp/kap8/statics/cd213a.htm
http://lectureonline.cl.msu.edu/~mmp/kap8/beam/beam.htm
http://lectureonline.cl.msu.edu/~mmp/kap8/cd217a.htm
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=41
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=34
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=15
http://www.schulphysik.de/java/physlet/applets/hooke.html
http://www.schulphysik.de/java/physlet/applets/stoss02.html
http://www.schulphysik.de/java/physlet/applets/stoss01.html
http://www.schulphysik.de/ntnujava/rotateDisk/pingpong.html
http://www.fernstudium-physik.de/medienserver/html/cgi/omsquery_cgi.exe?subject=Dynamik+starrer+ausgedehnter+Koerper&subsubject=&type=&search=&query=Suche+starten%21

http://www.phy.ntnu.edu.tw/java/FreeRolling/FreeRolling.html
http://www.phy.ntnu.edu.tw/java/racingBall/racingBall.html
http://www.phy.ntnu.edu.tw/java/Pendulum/Pendulum.html
http://www.phy.ntnu.edu.tw/java/wheelAxle/pulley.html
http://www.physik.uni-wuerzburg.de/video/mechanik2/mechanik2.html
http://www.explorelearning.com/index.cfm?method=cResource.dspResourcesForCourse&CourseID=310
http://pen.physik.uni-kl.de/physlets/animator4/rotations8_6_5.html
http://pen.physik.uni-kl.de/physlets/animator4/mechanics7_1_5.html

real solids and liquids

http://phys.educ.ksu.edu/vqm/html/pedsketcher.html
http://www.msu.edu/user/brechtjo/physics/atwood/atwood.html
http://lectureonline.cl.msu.edu/~mmp/applist/f/f.htm
http://lectureonline.cl.msu.edu/~mmp/kap5/work/work.htm
http://lectureonline.cl.msu.edu/~mmp/applist/si/plane.htm
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=17
http://em-ntserver.unl.edu/NEGAHBAN/Em325/intro.html
http://wings.avkids.com/Book/beginner.html
http://wings.avkids.com/Book/intermediate.html
http://wings.avkids.com/Book/advanced.html
http://didaktik.physik.uni-wuerzburg.de/~pkrahmer/ntnujava/friction/friction.html
http://didaktik.physik.uni-wuerzburg.de/~pkrahmer/ntnujava/wheelAxle/torque_e.html
http://jersey.uoregon.edu/vlab/FMA/index.html
http://didaktik.physik.uni-wuerzburg.de/~pkrahmer/ntnujava/collision2D/collision2D.html
http://jersey.uoregon.edu/vlab/PotentialEnergy/index.html
http://jersey.uoregon.edu/vlab/KineticEnergy/index.html
http://www.marshall.edu/physics/billiards.htm
http://physics.bu.edu/~duffy/semester1/c23_pressure_static.html
http://physics.bu.edu/~duffy/semester1/c23_pressure_pascal.html
http://physics.bu.edu/~duffy/semester1/c23_buoyant.html
http://physics.bu.edu/~duffy/semester1/c21_apparent.html
http://physics.bu.edu/~duffy/semester1/c21_arch_example.html
http://physics.bu.edu/~duffy/semester1/c24_efflux.html
http://didaktik.physik.uni-wuerzburg.de/~pkrahmer/ntnujava/buoyantForce/buoyantForce.html
http://www.physik.uni-stuttgart.de/institute/pi/5/lehre/versuche/versuche.html
http://thorin.adnc.com/~topquark/fun/JAVA/dho/dho.html
http://thorin.adnc.com/~topquark/fun/JAVA/collision/collision.html
http://www.phy.ntnu.edu.tw/java/friction/friction.html
http://www.phy.ntnu.edu.tw/java/collision2D/collision2D.html
http://www.phy.ntnu.edu.tw/java/collision1D/collision1D.html
http://www.physik.uni-wuerzburg.de/video/mechanik1/mechanik1.html
http://pen.physik.uni-kl.de/physlets/animator4/mechanics7_1_4.html

gases

http://www.phys.virginia.edu/classes/109N/more_stuff/Applets/brownian/brownian.html
http://www.falstad.com/gas/
http://comp.uark.edu/~jgeabana/mol_dyn/
http://surendranath.tripod.com/IdealGas/MolMotionApplet.html
http://lectureonline.cl.msu.edu/~mmp/kap10/cd283.htm
http://www.fernstudium-physik.de/medienserver/html/cgi/omsquery_cgi.exe?subject=Gase&subsubject=&type=&search=&query=Suche+starten%21

Interdisciplinary mechanics

flowing liquids and gases

http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=24
http://www.physik.uni-wuerzburg.de/video2/alpha/index.html
http://www.ibiblio.org/links/devmodules/dragforces/index.html

http://www.efluids.com/ (global 'web portal' to fluid mechanics)
http://pen.physik.uni-kl.de/medien/MM_Videos/index.html (see 'Download', 8 videos)
http://www.fernstudium-physik.de/medienserver/html/index.html (4 further videos, applets and web sites)
http://lectureonline.cl.msu.edu/~mmp/labs/labflow/lab.htm
http://www.aoe.vt.edu/~devenpor/aoe5104/ifm/ifm.html
http://www.engapplets.vt.edu/fluids/bls2/
http://www.aoe.vt.edu/~devenpor/aoe3114/calc.htmlhttp://physics.bu.edu/~duffy/semester1/c24_continuity.html
http://physics.bu.edu/~duffy/semester1/c24_curveball.html
http://www.multimedia-kl.fh-kl.de/mips/online/mips/left_video_sound.htm (see ‚Wirbel', 5 videoclips)
http://www.itsc.com/movies/ (animations)
http://www.grc.nasa.gov/WWW/K-12/airplane/foil2.html (excellent !?)
http://www.grc.nasa.gov/WWW/K-12/airplane/foil2b.html (excellent !?)
http://www-user.tu-chemnitz.de/~pester/exmpls.html (animations)
http://www.unibw-hamburg.de/MWEB/iss/fsl/pust/karman.html (4 videoclips, piv-method)
http://www.eng.fsu.edu/~shih/succeed/flow-vis.htm (website, piv-method)
http://www.eng.fsu.edu/~shih/succeed-2000/roadmap/wakejet.html (piv-method)
http://titles.cambridge.org/catalogue.asp?isbn=0521787483 ('Multimedia Fluid Mechanics CD-ROM, 256 videoclips)
http://www.fluidmechanicsvideo.com/ (commercial, video self-study course)
http://simscience.org/fluid/index.html
http://www.hlrs.de/organization/aw/services/cfd/
http://www.hlrs.de/organization/aw/services/cfd/Kreiszylinder/kreiszyl.html
http://www.hlrs.de/organization/aw/services/cfd/Wirbelpaar/wirbelpaar.html
http://www.hlrs.de/organization/aw/services/cfd/osz_Zylinder/oscZylinder.html
http://www.hlrs.de/organization/aw/services/cfd/stroembeispiele/staupu_1.html
http://www.hlrs.de/organization/aw/services/cfd/stroembeispiele/staupu_2.html
http://www.diam.unige.it/~irro/
http://physik1.physik.uni-heidelberg.de/vrlsg/start.htm
http://www.physik.uni-stuttgart.de/institute/pi/5/lehre/versuche/versuche.html (5 videoclips)
http://www.physik.ph-ludwigsburg.de/physikonline/video1/welcome.html
http://www.rawbw.com/~xmwang/myGUI/MagnusG.html
http://www.rawbw.com/~xmwang/javappl/magnusF3.html
http://www.rawbw.com/~xmwang/javappl/magnusF12.html
http://www.rawbw.com/~xmwang/javappl/magnusF1260.html
http://www.rawbw.com/~xmwang/javappl/magnusF18.html
http://www.rawbw.com/~xmwang/javappl/magnusF30.html
http://www.rawbw.com/~xmwang/javappl/magnusF45.html
http://www.iwf.de (about 30 videos can be borrowed, 1960-1990)
http://www.fernstudium-physik.de/medienserver/html/cgi/omsquery_cgi.exe?subject=Stroemende+Fluessigkeiten+und+Gase&subsubject=&type=&search=&query=Suche+starten%21
http://www.physik.uni-wuerzburg.de/video/mechanik4/mechanik4.html

mechanical oscillations and waves

http://www.openteach.com/astronomy/doppler.html
http://www.falstad.com/modebox/
http://www.msu.edu/user/brechtjo/physics/oscillator/oscillator.html
http://www.msu.edu/user/brechtjo/physics/pendulum/pendulum.html
http://lectureonline.cl.msu.edu/~mmp/applist/damped/d.htm
http://lectureonline.cl.msu.edu/~mmp/kap13/cd363a.htm
http://lectureonline.cl.msu.edu/~mmp/kap13/cd361a.htm
http://www.physik.uni-bielefeld.de/~projekt/stehende/index.html
http://lectureonline.cl.msu.edu/~mmp/applist/coupled/osc2.htm
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=37
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=31
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=18
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=21
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=20
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=44

http://www.ibiblio.org/links/devmodules/springmass/index.html
http://www.ibiblio.org/links/devmodules/forcedsm/index.html
http://monet.physik.unibas.ch/~elmer/flab/coulombSlider/index.html
http://monet.physik.unibas.ch/~elmer/flab/FKModel/index.html
http://monet.physik.unibas.ch/~elmer/flab/FKTModel/index.html
http://monet.physik.unibas.ch/~elmer/pendulum/
http://www.physik.tu-freiberg.de/~na/schwingungen.html
http://www.schulphysik.de/java/physlet/applets/fkt1.html
http://www.schulphysik.de/java/physlet/applets/schwing1.html
http://www.rawbw.com/~xmwang/
http://www.fernstudium-physik.de/medienserver/html/cgi/omsquery_cgi.exe?subject=Mechanische+Schwingungen+und+Wellen&subsubject=&type=&search=&query=Suche+starten%21
http://pen.physik.uni-kl.de/physlets/animator4/demo_hook.html
http://pen.physik.uni-kl.de/physlets/EField4/mechanics7_1_7.html

nonlinear dynamics and chaos

http://www.math.ubc.ca/~feldman/demos/pendulum.html
http://math.bu.edu/DYSYS/applets/chaos-game.html
http://math.bu.edu/DYSYS/applets/fractalina.html
http://math.bu.edu/DYSYS/applets/franimate.html
http://math.bu.edu/DYSYS/applets/linear-web.html
http://math.bu.edu/DYSYS/applets/nonlinear-web.html
http://math.bu.edu/DYSYS/applets/targetPractice.html
http://math.bu.edu/DYSYS/applets/cyclePractice.html
http://math.bu.edu/DYSYS/applets/OrbitDiagram.html
http://www.math.tu-cottbus.de/INSTITUT/lsam/CompPhysik/LogisticMap/LogPhase.html
http://www.math.tu-cottbus.de/INSTITUT/lsam/CompPhysik/HenonMap/HenonPhase.html
http://www.math.tu-cottbus.de/INSTITUT/lsam/CompPhysik/LorenzAtt/index.html
http://www.expm.t.u-tokyo.ac.jp/~kanamaru/Chaos/e/Harper/HarpApp.html
http://www.expm.t.u-tokyo.ac.jp/~kanamaru/Chaos/e/Standard/StanApp.html
http://www.expm.t.u-tokyo.ac.jp/~kanamaru/Chaos/e/RiddledBasin/Large/RiddledBasin.html
http://www.expm.t.u-tokyo.ac.jp/~kanamaru/Chaos/e/Newton/Large/Newton.html
http://www.expm.t.u-tokyo.ac.jp/~kanamaru/Chaos/e/Pendulum/pendulum.html
http://www.expm.t.u-tokyo.ac.jp/~kanamaru/Chaos/e/BifArea/BifApp.html
http://www.expm.t.u-tokyo.ac.jp/~kanamaru/Chaos/e/Logits/logits.html
http://www.matheprisma.uni-wuppertal.de/Module/Fraktal/index.htm
http://www.cmp.caltech.edu/~mcc/chaos_new/Scalemap.html
http://www.maths.tcd.ie/~plynch/SwingingSpring/Applet.html
http://math.bu.edu/DYSYS/arcadia/index.html
http://hypertextbook.com/chaos/
http://order.ph.utexas.edu/chaos/
http://www.apmaths.uwo.ca/~bfraser/version1/index.html
http://pen.physik.uni-kl.de/physlets/ode/param_osz.html

Appendix 2

List of criteria

Title:	
Author:	
Topic:	
URL:	

			Rating*	Comments
motivation	User-friendliness	Is it easy to start using the MM?		
		Are the design comprehensible and the image quality satisfactory?		
		Is the function of control elements evident?		
		Are the software requirements clear and of adequate proportion?		
	Attractiveness:	Is the layout appealing?		
		Is there a motivating introduction?		
		Are there interactive components?		
		Is the topic interesting (reference to everyday life, applications, explaining a phenomenon)?		
		Is the MM up-to-date / innovative?		
	Clear description of purpose and work assignment:	Is the intention of the MM evident?		
		Does the user know what is expected from him?		
		Is there a problem to solve or a context to understand?		
content	Relevance	Is the topic important?		
		Does it make sense to use the MM (e.g. problems in understanding, dynamic process)?		
	Scope	Is there a profoundness of content?		
		Is there a broadness of content (special case, general overview)?		
	Correctness	Is the content of the MM correct?		
		Are simplifications indicated?		
method	Flexibility	Is the MM appropriate for a broad target group (incl. self-learning)?		
		Is it possible to use the MM in different teaching and learning situations?		
		Does the MM allow for the same topic to be approached in different ways?		
	Matching to target group	Is a reasonable didactical reduction implemented?		
		Are technical terms explained?		
		Are the objectives appropriate?		
	Realization	Is the general approach suitable to present the subject and realize aims of the given MM?		
		Is the type of MM chosen reasonable (video, simulation, animation)?		
	Documentation	Is the operation obvious or explained?		
		Is the material self-evident or explained by additional text?		
		Is there a reference to material for further studies?		
		Are there any suggestions for implementation into the teaching process?		

Appendix 3

Evaluation forms of recommended material

Title:	Motion and force			
Author:	ExploreLearning			
Topic:	Motion and force			
URL:	http://www.explorelearning.com/index.cfm?method=cResource.dspResourcesForCourse&CourseID=330			
			Rating	Comments
motivation	User-friendliness	Is it easy to start using the MM?	+	Subscription needed
		Are the design comprehensible and the image quality satisfactory?	++	
		Is the function of control elements evident?	++	
		Are the software requirements clear and of adequate proportion?	+	
	Attractiveness:	Is the layout appealing?	++	
		Is there a motivating introduction?	+	
		Are there interactive components?	++	
		Is the topic interesting (reference to everyday life, applications, explaining a phenomenon)?	++	
		Is the MM up-to-date / innovative?	++	
	Clear description of purpose and work assignment:	Is the intention of the MM evident?	+	
		Does the user know what is expected from him?	+	
		Is there a problem to solve or a context to understand?	+	
content	Relevance	Is the topic important?	+	
		Does it make sense to use the MM (e.g. problems in understanding, dynamic process)?	+	
	Scope	Is there a profundness of content?	0	
		Is there a broadness of content (special case, general overview)?	+	
	Correctness	Is the content of the MM correct?	+	
		Are simplifications indicated?	0	
method	Flexibility	Is the MM appropriate for a broad target group (incl. self-learning)?	+	
		Is it possible to use the MM in different teaching and learning situations?	++	
		Does the MM allow for the same topic to be approached in different ways?	+	
	Matching to target group	Is a reasonable didactical reduction implemented?	+	
		Are technical terms explained?	+	
		Are the objectives appropriate?	+	
	Realization	Is the general approach suitable to present the subject and realize aims of the given MM?	+	
		Is the type of MM chosen reasonable (video, simulation, animation)?	0	
	Documentation	Is the operation obvious or explained?	+	Varies depending on topic
		Is the material self-evident or explained by additional text?	+	
		Is there a reference to material for further studies?	++	
		Are there any suggestions for implementation into the teaching process?	++	

Title:	FIPS Medienserver
Author:	FIPS Team, Wolfgang Christian
Topic:	Various applets and videos about mass point mechanics
URL:	http://www.fernstudium-physik.de/medienserver/html/cgi/omsquery_cgi.exe?subject=Mechanik+eines+Massenpunktes&subsubject=&type=&search=&query=Suche+starten%21

			Rating	Comments
motivation	User-friendliness	Is it easy to start using the MM?	++	
		Are the design comprehensible and the image quality satisfactory?	++	
		Is the function of control elements evident?	++	
		Are the software requirements clear and of adequate proportion?	0	
	Attractiveness:	Is the layout appealing?	++	
		Is there a motivating introduction?	0	
		Are there interactive components?	+	
		Is the topic interesting (reference to everyday life, applications, explaining a phenomenon)?	+	
		Is the MM up-to-date / innovative?	+	
	Clear description of purpose and work assignment:	Is the intention of the MM evident?	++	
		Does the user know what is expected from him?	+	
		Is there a problem to solve or a context to understand?	++	
content	Relevance	Is the topic important?	+	
		Does it make sense to use the MM (e.g. problems in understanding, dynamic process)?	++	
	Scope	Is there a profundness of content?	0	
		Is there a broadness of content (special case, general overview)?	+	
	Correctness	Is the content of the MM correct?	+	
		Are simplifications indicated?	0	
method	Flexibility	Is the MM appropriate for a broad target group (incl. self-learning)?	+	
		Is it possible to use the MM in different teaching and learning situations?	+	
		Does the MM allow for the same topic to be approached in different ways?	+	
	Matching to target group	Is a reasonable didactical reduction implemented?	+	
		Are technical terms explained?	0	
		Are the objectives appropriate?	+	
	Realization	Is the general approach suitable to present the subject and realize aims of the given MM?	+	
		Is the type of MM chosen reasonable (video, simulation, animation)?	++	
	Documentation	Is the operation obvious or explained?	++	
		Is the material self-evident or explained by additional text?	+	
		Is there a reference to material for further studies?	+	
		Are there any suggestions for implementation into the teaching process?	0	

Title:	Particle World			
Author:	Fredrik Karlsson			
Topic:	System of mass points			
URL:	http://www.ifm.liu.se/~freka/particleworld/			
			Rating	Comments
motivation	User-friendliness	Is it easy to start using the MM?	0	The demo simulations did not start when trying it for the second time, I had to quit the browser and start again
		Are the design comprehensible and the image quality satisfactory?	++	
		Is the function of control elements evident?	++	
		Are the software requirements clear and of adequate proportion?	++	
	Attractiveness:	Is the layout appealing?	++	
		Is there a motivating introduction?	+	
		Are there interactive components?	++	
		Is the topic interesting (reference to everyday life, applications, explaining a phenomenon)?	++	
		Is the MM up-to-date / innovative?	++	
	Clear description of purpose and work assignment:	Is the intention of the MM evident?	++	
		Does the user know what is expected from him?	++	
		Is there a problem to solve or a context to understand?	++	
content	Relevance	Is the topic important?	++	
		Does it make sense to use the MM (e.g. problems in understanding, dynamic process)?	++	
	Scope	Is there a profundness of content?	++	
		Is there a broadness of content (special case, general overview)?	++	
	Correctness	Is the content of the MM correct?		It seems so, but there are several different situations, and one cannot check the precision of the integration
		Are simplifications indicated?	+	
method	Flexibility	Is the MM appropriate for a broad target group (incl. self-learning)?	++	several configurations received and attached from other contributors
		Is it possible to use the MM in different teaching and learning situations?	++	
		Does the MM allow for the same topic to be approached in different ways?	++	
	Matching to target group	Is a reasonable didactical reduction implemented?	++	
		Are technical terms explained?	+	
		Are the objectives appropriate?	++	
	Realization	Is the general approach suitable to present the subject and realize aims of the given MM?	++	
		Is the type of MM chosen reasonable (video, simulation, animation)?	++	
	Documentation	Is the operation obvious or explained?	++	The method of integration is not explained. The construction of the equations (not given) for such a large set of configurations is the real original invention in this project
		Is the material self-evident or explained by additional text?	++	
		Is there a reference to material for further studies?	0	not necessary, it is so broad anyway
		Are there any suggestions for implementation into the teaching process?	0	

Title:	Motion of a Ping-Pong
Author:	Fu-Kwun Hwang
Topic:	Rigid rotation
URL:	http://www.schulphysik.de/ntnujava/rotateDisk/pingpong.html

			Rating	Comments
motivation	User-friendliness	Is it easy to start using the MM?	++	
		Are the design comprehensible and the image quality satisfactory?	0	I'd prefer thicker lines
		Is the function of control elements evident?	++	
		Are the software requirements clear and of adequate proportion?	++	
	Attractiveness:	Is the layout appealing?	0	
		Is there a motivating introduction?	+	
		Are there interactive components?	+	
		Is the topic interesting (reference to everyday life, applications, explaining a phenomenon)?	++	
		Is the MM up-to-date / innovative?	++	
	Clear description of purpose and work assignment:	Is the intention of the MM evident?	++	
		Does the user know what is expected from him?	++	
		Is there a problem to solve or a context to understand?	++	
content	Relevance	Is the topic important?	++	
		Does it make sense to use the MM (e.g. problems in understanding, dynamic process)?	++	
	Scope	Is there a profundness of content?	++	
		Is there a broadness of content (special case, general overview)?	0	
	Correctness	Is the content of the MM correct?	++	
		Are simplifications indicated?	0	energy dissipation by rotational drag is not included
method	Flexibility	Is the MM appropriate for a broad target group (incl. self-learning)?	++	
		Is it possible to use the MM in different teaching and learning situations?	++	
		Does the MM allow for the same topic to be approached in different ways?	0	
	Matching to target group	Is a reasonable didactical reduction implemented?	++	
		Are technical terms explained?	0	
		Are the objectives appropriate?	+	
	Realization	Is the general approach suitable to present the subject and realize aims of the given MM?	++	
		Is the type of MM chosen reasonable (video, simulation, animation)?	++	
	Documentation	Is the operation obvious or explained?	+	
		Is the material self-evident or explained by additional text?	++	
		Is there a reference to material for further studies?	--	
		Are there any suggestions for implementation into the teaching process?	-	

Title:	Aeronautics Resources			
Author:	NASA Glenn Research Center			
Topic:	Flowing liquids and gases			
URL:	http://www.grc.nasa.gov/www/K-12/aerores.htm			
			Rating	Comments
motivation	User-friendliness	Is it easy to start using the MM?	++	
		Are the design comprehensible and the image quality satisfactory?	++	
		Is the function of control elements evident?	++	
		Are the software requirements clear and of adequate proportion?	++	
	Attractiveness:	Is the layout appealing?	-	
		Is there a motivating introduction?	-	
		Are there interactive components?	++	
		Is the topic interesting (reference to everyday life, applications, explaining a phenomenon)?	++	
		Is the MM up-to-date / innovative?	+	
	Clear description of purpose and work assignment:	Is the intention of the MM evident?	++	
		Does the user know what is expected from him?	++	
		Is there a problem to solve or a context to understand?	-	
content	Relevance	Is the topic important?	++	
		Does it make sense to use the MM (e.g. problems in understanding, dynamic process)?	++	
	Scope	Is there a profundness of content?	++	
		Is there a broadness of content (special case, general overview)?	++	
	Correctness	Is the content of the MM correct?	++	
		Are simplifications indicated?	+	
method	Flexibility	Is the MM appropriate for a broad target group (incl. self-learning)?	++	There are program versions for less and more advanced students. Many Applets can be downloaded and used out of Internet.
		Is it possible to use the MM in different teaching and learning situations?	+	
		Does the MM allow for the same topic to be approached in different ways?	+	
	Matching to target group	Is a reasonable didactical reduction implemented?	++	Aerospace Activities and Lessons are created by active teachers, educators and scientists for the use of school teachers.
		Are technical terms explained?	++	
		Are the objectives appropriate?	++	
	Realization	Is the general approach suitable to present the subject and realize aims of the given MM?	+	
		Is the type of MM chosen reasonable (video, simulation, animation)?	++	
	Documentation	Is the operation obvious or explained?	++	In the part about Rockets and Kites there are Teacher's Guide and Lesson Plans
		Is the material self-evident or explained by additional text?	++	
		Is there a reference to material for further studies?	++	
		Are there any suggestions for implementation into the teaching process?	+	

Title:	Oscillations and Waves, Acoustics
Author:	Paul Falstad
Topic:	Mechanical Oscillations and Waves
URL:	http://www.falstad.com/mathphysics.html

			Rating	Comments
motivation	User-friendliness	Is it easy to start using the MM?	++	In some more advanced cases you have to read Applet's instructions carefully.
		Are the design comprehensible and the image quality satisfactory?	+	
		Is the function of control elements evident?	0	
		Are the software requirements clear and of adequate proportion?	++	
	Attractiveness:	Is the layout appealing?	-	All Applets are interactive with many parameters to change. The Applets deal with more ambitious physical problems than the other pages on the topic
		Is there a motivating introduction?	--	
		Are there interactive components?	++	
		Is the topic interesting (reference to everyday life, applications, explaining a phenomenon)?	+	
		Is the MM up-to-date / innovative?	+	
	Clear description of purpose and work assignment:	Is the intention of the MM evident?	+	The page contains Applets with links to relevant physics mainly. The problems to solve are rare..
		Does the user know what is expected from him?	+	
		Is there a problem to solve or a context to understand?	-	
content	Relevance	Is the topic important?	++	
		Does it make sense to use the MM (e.g. problems in understanding, dynamic process)?	++	
	Scope	Is there a profundness of content?	+	
		Is there a broadness of content (special case, general overview)?	-	
	Correctness	Is the content of the MM correct?	++	
		Are simplifications indicated?	0	
method	Flexibility	Is the MM appropriate for a broad target group (incl. self-learning)?	-	It is university level only - material is useful for the presentation during lectures.
		Is it possible to use the MM in different teaching and learning situations?	-	
		Does the MM allow for the same topic to be approached in different ways?	-	
	Matching to target group	Is a reasonable didactical reduction implemented?	+	
		Are technical terms explained?	0	
		Are the objectives appropriate?	+	
	Realization	Is the general approach suitable to present the subject and realize aims of the given MM?	0	There are interactive Java Applets only but they are reasonable MM to present oscillations.
		Is the type of MM chosen reasonable (video, simulation, animation)?	+	
	Documentation	Is the operation obvious or explained?	+	
		Is the material self-evident or explained by additional text?	0	
		Is there a reference to material for further studies?	+	
		Are there any suggestions for implementation into the teaching process?	--	

Title:	Introduction to Chaos and Nonlinear Dynamics			
Author:	Takashi Kanamaru and J. Michael T. Thompson			
Topic:	Collection of over 20 Java-applets			
URL:	http://www.sekine-lab.ei.tuat.ac.jp/~kanamaru/Chaos/e/			
			Rating	Comments
motivation	User-friendliness	Is it easy to start using the MM?	++	
		Are the design comprehensible and the image quality satisfactory?	+	
		Is the function of control elements evident?	++	
		Are the software requirements clear and of adequate proportion?	++	
	Attractiveness:	Is the layout appealing?	0	
		Is there a motivating introduction?	--	
		Are there interactive components?	+	
		Is the topic interesting (reference to everyday life, applications, explaining a phenomenon)?	0	
		Is the MM up-to-date / innovative?	+	
	Clear description of purpose and work assignment:	Is the intention of the MM evident?	++	
		Does the user know what is expected from him?	++	
		Is there a problem to solve or a context to understand?	+	
content	Relevance	Is the topic important?	+	
		Does it make sense to use the MM (e.g. problems in understanding, dynamic process)?	++	
	Scope	Is there a profundness of content?	+	
		Is there a broadness of content (special case, general overview)?	0	
	Correctness	Is the content of the MM correct?	++	
		Are simplifications indicated?	+	
method	Flexibility	Is the MM appropriate for a broad target group (incl. self-learning)?	-	
		Is it possible to use the MM in different teaching and learning situations?	0	
		Does the MM allow for the same topic to be approached in different ways?	--	
	Matching to target group	Is a reasonable didactical reduction implemented?	0	
		Are technical terms explained?	0	
		Are the objectives appropriate?	+	
	Realization	Is the general approach suitable to present the subject and realize aims of the given MM?	+	
		Is the type of MM chosen reasonable (video, simulation, animation)?	+	
	Documentation	Is the operation obvious or explained?	+	
		Is the material self-evident or explained by additional text?	0	
		Is there a reference to material for further studies?	++	
		Are there any suggestions for implementation into the teaching process?	--	