FY05 Innovations in Teaching with Technology Awards: webMathematica Support for Vector Calculus

Proposal Title: webMathematica Support for Vector Calculus

Investigators: Keith Stroyan

Org Unit: College of Liberal Arts & Sciences

Department(s): Mathematics

Funding Awarded: $24,000

We propose to develop a web site to support a full spectrum of multivariable or vector calculus courses. (This includes 22M:28, 32, 37 & 56.)

Subjects as diverse as actuarial science and thermodynamics deal with simultaneous changes in several variables. Multivariable calculus is also an important course in our secondary teacher training because it combines geometry and analysis in a deep way. This proposal will support a fundamentally important subject.

We propose development of a systematic set of tools for any vector calculus course, but our main initial development emphasis will be to serve Engineering Math 2 (22M:32, annual enrollment ~350).

There are many excellent vector calculus topics treated on the web. However, they tend to be on isolated topics and often do not let students compute their own examples. Our proposed web support will contain a systematic set of automatic solvers for all the basic examples and by their nature will allow users to experiment with similar examples.

These tools will allow students to experiment with text-like examples. The site will include interactive examples computed by webMathematica on our server that allow students or instructors to perform symbolic, graphical, and numerical computations from input on their web browser. For example, webMathematica can draw the explicit or contour graph of f(x,y) and a tangent when the user enters f(x,y) and the point of tangency. The solver can also compute the symbolic tangent equation and allow the user to "zoom in" to the point of tangency. Interactive web examples of tangents, integrals, motion with velocity and acceleration, vector fields, etc., can help people teach and learn the subject in the full spectrum of these courses.
The web tools will be based on many years of effort Stroyan has devoted to developing an interactive text written in Mathematica. (see: [http://www.math.uiowa.edu/~Estroyan/multicalc.htm](http://www.math.uiowa.edu/~Estroyan/multicalc.htm)) Many examples, movable graphs, and animations in those materials have underlying Mathematica code that can be converted to webMathematica and made more interactive so students can modify and experiment with them.

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<th>What resources will you need?</th>
<th>A small server computer and a half-time R.A. for an academic year (2005-6).</th>
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<tbody>
<tr>
<td>Rough estimate of costs</td>
<td>$24,000</td>
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Article number: 101163