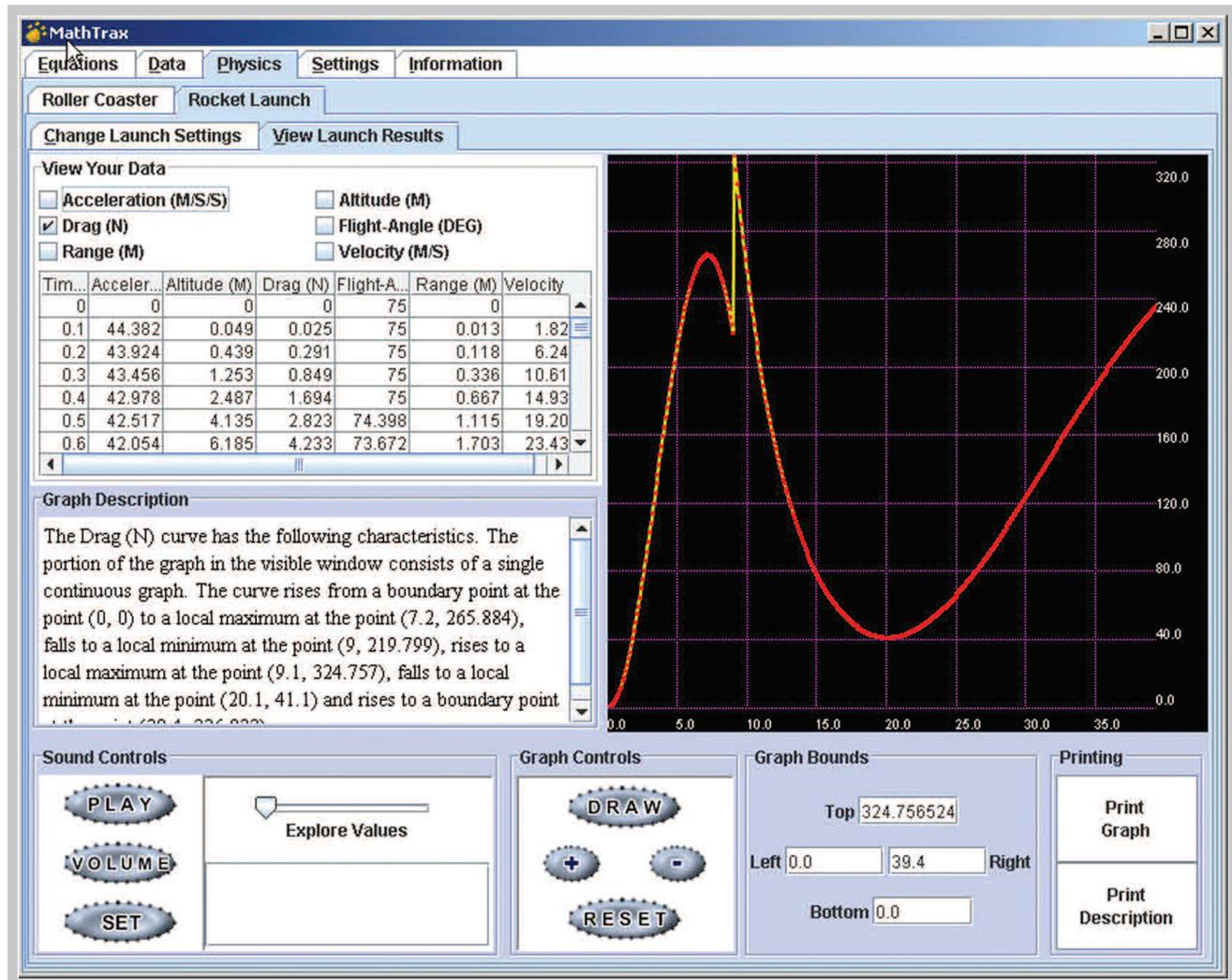


Math Education Software for Blind and Visually Impaired Students Released as Open Source

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NASA math software display.

The Johnson Space Center Learning Technologies team recently released the critically acclaimed Math Description Engine Software Development Kit (MDE SDK) as Open Source software. The MDE SDK is a reusable software library that generates text, sound, and visual representations of equations, data tables, and simulations. It creates dynamic text descriptions of information that

makes visual scientific data accessible to blind and visually impaired (BVI) users. This innovative Open Source software library may forever change how BVI users “see” complex graphs and datasets.

The MDE SDK advances the art of accessible software by determining key data characteristics “on the fly.” These key characteristics are formed into natural-language text

descriptions that BVI students and scientists use to interpret spatial data and relationships. BVI computer users access these alternative text and sound descriptions using computer screen readers and standard computer speakers.

The recent Open Source release of the MDE SDK provides all Web and software developers the opportunity to add text descriptions and sounds to their own software applications using the simple MDE Application Programming Interface. The software modules that generate the text and sound can be used independently or together. The MDE architecture supports synchronization among modules when text, sound, and graphing are used in combination.

The MDE SDK was used to create the graphing calculator MathTrax, a powerful learning tool for blind and sighted users alike. MathTrax is a virtual math and science assistant that engages both the eyes and ears of students to increase overall learning comprehension. It enables students to explore, discover, and understand math using multiple approaches. The text descriptions and the “audio graphs” of math equations provide ways of accessing information that might have otherwise been unavailable.

A practical use of the MDE-based application MathTrax occurred during the “Rocket On!” summer science camp, which is an annual event co-sponsored by NASA and the National Federation of the Blind. Students used MathTrax to design and model a 10-ft sounding rocket, determine its flight path, and later analyze the flight and payload data. A 16-year-old vision-impaired student commented, “This week has been an amazing opportunity. Through the use of the graphing calculator, our group was able to make sound predictions regarding flight.”

The MDE SDK library modules use a combination of rule and computation-based artificial intelligence, graphing techniques, and sonification to classify, describe, and display data. For example: When a user enters an equation into the MDE application MathTrax, the Solver module converts the equation into canonical form by evaluating signs, coefficients, and discriminants. Through a process of algebraic reduction, the equation is classified into one of a set of identified cases or solved graphs. The Solved Graph

module contains a number of cases for conic sections with specific attributes for each case. Based on the case type of the equation and the specific attributes of the equation, the appropriate feature characteristics are generated in the Descriptor, Grapher, and Sonifier modules for display and audio playback.

The MDE generates text descriptions for two-dimensional graphs commonly seen in math and science curriculum and professional practice. The Java-based toolkit has a set of accessible Java Swing components that enables user-controlled viewing and analysis of graphs using sound. The user receives a textual description and a graph of the equation along with the ability to sonify the graph information.

Professional users of the MDE SDK include: developers of education products and support tools; special needs education researchers; assistive technology researchers and vendors; the accessible Web community; sonification researchers; and organizations with Web sites containing graphical data displays. MathTrax is available for Windows and Macintosh platforms and is a free download from the project’s Web site (<http://prime.jsc.nasa.gov/mde/>) and from SourceForge (<http://sourceforge.net/projects/mde-sdk/>). By downloading the software, you can play an integral role in developing the future of accessible graphing technology.

For more information about the MDE SDK or MathTrax, email info@prime.jsc.nasa.gov or visit the Information Accessibility Lab at <http://prime.jsc.nasa.gov/>.