

Fourth International Derive TI-89/92 Conference

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New Computer Integrated Mathematics Teaching at the Swedish Natural Science Program

David Sjöstrand
Elof Lindaelvs Gymnasium, Sweden
Email: david@ydsa.se

Background

The importance of mathematics is rapidly increasing in modern society. Many of the recent technological developments e.g. mobile telephones, GPS-navigating, video, weather forecasts, Simulation of chemical reactions, Simulation of real life sequences on film (e.g. "Titanic"), are dependent on modern mathematics and on powerful computers used to perform huge calculations, which not far ago were impossible to carry through. There are mathematical problems, that earlier were impossible to solve, which now can be handled by upper secondary school students using the power of a computer.

A New Concept

We now offer a new and unique math teaching method at the Natural Science Programme at Elof Lindaelvs gymnasium starting in the Autumn term year 2000. We will integrate the use of computers in the math courses. This will really help the students to an increased understanding of important and fundamental mathematical ideas. It will also make it possible to deal with more realistic, real world applications The most important reason for using computers in math teaching is to make mathematics fun and enjoyable.

Since 1995 we have offered a local course, "[Computers and Mahtematics](#)". This course has provided us experiences and knowledge which has made it natural to offer all students at the Natural Science Programme an extensive use of computers in mathematics.

Of course, math teaching will follow the national curriculum for mathematics. We will work to reach all national goals. The prerequisites of making a meaningful use of computers in mathematics are very good - students are used to work with computers and almost all students have a PC at home – very good mathematical soft wares are available.

New Mathematical Tasks

The most important task for a math teacher is to inspire the students to solve interesting and enjoyable mathematical problems. Thanks to DERIVE, DPGraph, Excel, Cabri and other soft wares the number of such problems suitable for secondary school students has increased considerably.

We are convinced that the following holds.

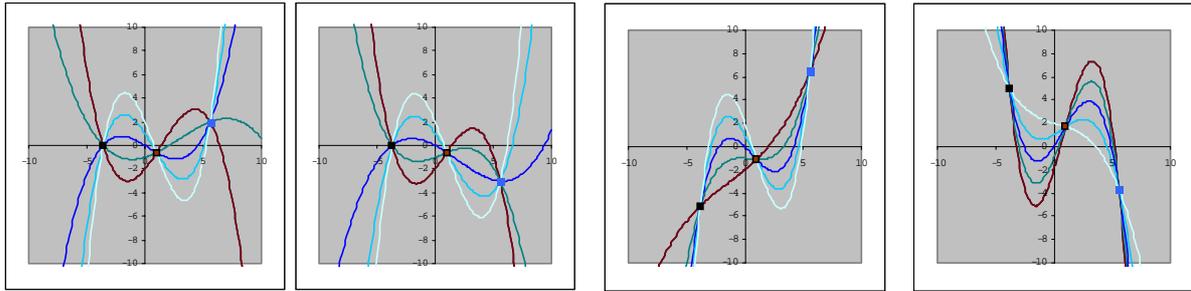
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If your secondary school students have access to DERIVE and perhaps DPGraph, Excel, Cabri and other software, the number of interesting and enjoyable mathematical problems for your students is infinite.

As examples of, according to our experience, enjoyable problems, we can mention:

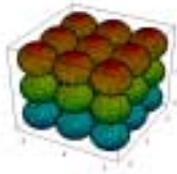
1. Curves depending on parameters

Visualise the set of third degree curves passing three given points

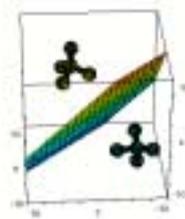


You can use DERIVE to generate the formulas you need. These formulas can be exported to Excel where you easily can change the given points.

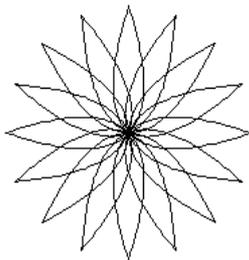
2. Use principles for reflections - shifts and rotations of objects on a computer screen to create the figures below



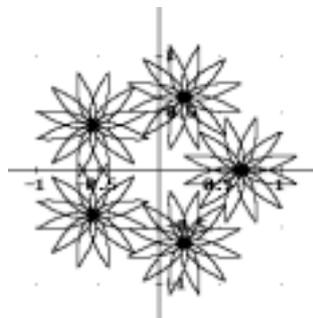
A sphere and 26 shifts of this sphere.



A methane molecule and its mirror image in a plane.



A lot of parabolas.

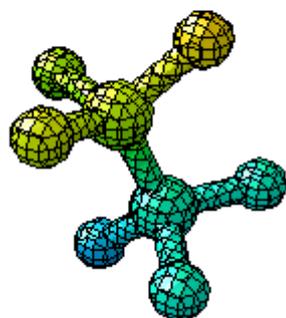


Even more parabolas.

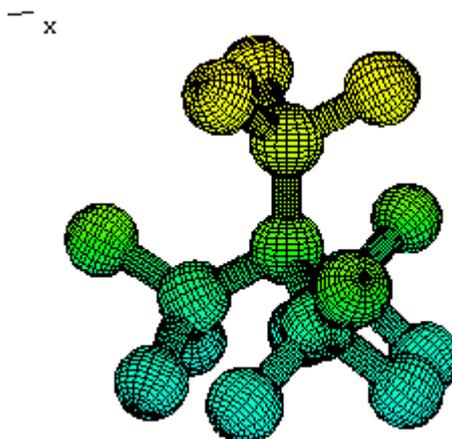


A lot of circles

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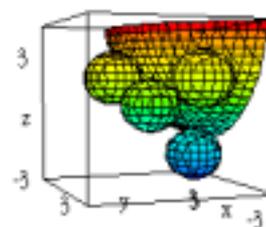
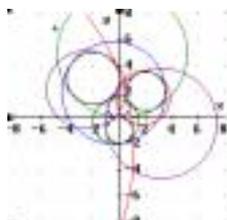
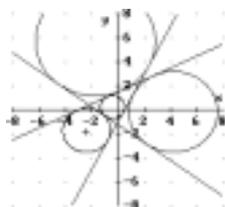
Ethane molecule created with DERIVE and DPGraph



Tetramethylmethane molecule created with DERIVE.

3. Algebraic solution to geometric problems

- Find (all) circles tangent to three given lines.
- Find (all) spheres tangent to four given planes.
- Find (all) circles tangent to three given circles.
- Find (all) spheres tangent to four given spheres.



You can solve the above problems by solving systems of second degree equations. You can use DERIVE 5 to do this. DERIVE gives a complete solution which means that you can prove algebraically that you really have found all circles and spheres respectively.

- The system has at most 4 solutions which means that the number of circles is 4.
- The system has at most 8 solutions which means that the number of spheres is 8.
- You can prove that there are at most 8 systems of equations giving each possible circle.
- You can prove that there are at most 16 systems of equations giving each possible sphere.

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Final remarks

Computer integrated math teaching allows the students to work in a more independent way. They will meet project tasks and they will not spend all of their time listening to the teacher or solving problems from their textbook. Some of the project tasks will be so big that they will have to work in groups where they have to make a suitable division of their labour. They will also be asked to give different kinds of presentations of their work

The software packages, DERIVE, DPGraph, Excel and Cabri, we plan to use are very simple to run. Therefore, we believe that the difficulties the students will meet in their math classes are purely mathematical. There will only be very small problems in handling the software.