Re: A challenging 3 equations and 3 unknowns

Source: http://sci.tech−archive.net/Archive/sci.math.symbolic/2009−04/msg00011.html

- *From*: pnachtwey <pnachtwey@xxxxxxxxx>
- *Date*: Thu, 2 Apr 2009 06:14:22 −0700 (PDT)

On Apr 1, 8:32 pm, "Robert H. Lewis" <rle...@xxxxxxxxxxx> wrote:

> The is post on this forum
> about finding the
>
> location
>
> and size of a
> circle using three ultrasonic
> sensors. The thread is
> here:
>
> http://www.plctalk.net/qanda/showthread.php?p=316629#post316629
>
> My wxMaxima doesn't seem
> to be getting the job
>
> done.
>
> eq1:
> (x1−x0)^2+(y1−y0)^2−(r0+r1)^2;
> eq2:
> (x2−x0)^2+(y2−y0)^2−(r0+r2)^2;
> eq3:
> (x3−x0)^2+(y3−y0)^2−(r0+r3)^2;
> eq4:
> solve([eq1,eq2,eq3],[x0,y0,r0]);
>
> This sort of thing is very easy to do
>
> symbolically

with resultants. I only have a minute now,
but

you

might look at

http://fordham.academia.edu/RobertLewis/Papers/82784/

Apollonius−Probl...

Robert H. Lewis
Fordham University

I computed the 3 resultants. Each takes about

0.019 seconds. This probably duplicates Dan
Lichtblau's result, but here is the resultant for x0
in nested form: .....

+ ((−2y1^2)x2^2 − y1^4 + (−2x1^2)y1^2 − x1^4)y2^2 +

((2y1^3 + (2x1^2)y1)x2^2)y2 + (−y1^2)

x2^4

It's just quadratic, so this ought to be quite

useful.
Someone should write a universal graphical interface
to Fermat using
wxWidgets or Java Swing or similar.

Please do!

If you read the first post I posted a link to the
problem onwww.plcs.net. This for for someone else and I doubt they need a
3d
version. I have been e−mail the complete solution. At least I think
it is. It is so long it is hard to make heads or tails out of it. In
any case the OP on the plc forum said this must run on a PLC so the

> symbolic solution is way too complex. I agree with Daniel Lichtblau
> that a practical solution will require iteration.
>
> Peter Nachtwey

> I just read the post you quote from the other forum. What is a PLC? I gather this is some kind
> of very small processor?

A PLC, programmable logic controller, is an industrial computer that is used in industrial control systems. Most programming is done in ladder logic. Here is a text from a respected professor in controls. Note this has little to do with symbolic processing. I recommend that you just skim it to get the idea.
http://claymore.engineer.gvsu.edu/~jackh/books/plcs/pdf/plcbook5_1.pdf
http://sites.google.com/site/automatedmanufacturingsystems/
PLCs are powerful but not as powerful as PC because PLCs must be able to run without a fan in very hot conditions so processing power is limited by how much heat that can be dissipated. Low power micro controllers like ARM and Atom processors are used. They have firmware that simulates programming using relays and while they can do math. These are the kinds of computers that electricians and industrial engineers use to keep the factories working.

I monitor the sites because my company makes motion controllers that are used in industrial control. My questions usually deal with motion profile generation.

> If, as the original post indicates, the three points are on an equilateral triangle, that could probably simplify the formulas.

I am not sure how. The equations seem pretty simple as they are. However, that is one of the reasons I posted the question here because I know there are better mathematicians here than I am that would tell me if the three equations and three unknowns could be simplified. I did try using the 'assume()' function to specify that all the distances are positive. I saw this problem like you do. The inner circle fits between three other circles with radii of the distances from the ultra sonic transducers. Your comment about the 3D solution finding the location of a sphere in a tetrahedron is interesting but I don't think we need to go there.

Back in the 80s we would solve problems like this iteratively. We

didn't know about LFBGS or Levenberg−Marquardt back then and symbolic solutions were a dream. The log would move end wise between the three sensors and a circular cross section would be approximated for every foot of travel. Computers, HP1000s or PDP−11, would when find the best way to cut the log.

Peter Nachtwey
.