Re: Fast solution to very small eigenvalue problem

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From: Julian V. Noble (*jvn_at_virginia.edu*)
Date: 06/25/04

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Mark Mackey wrote:
>
> Hi all.
>
> I need to find the eigenvector corresponding to the largest eigenvalue
> of a 4x4 matrix very quickly (because I'm doing it on hundreds of
> thousands of 4x4 matrices). The current code I'm maintaining has a
> simple Jacobi solver, which is (a) slow (it only does 30K matrices/s on
> my PC), and (b) probably overkill, as it returns all of the
> eigenvectors. I've vaguely looked at LAPACK etc, but those routines are
> AFAIK optimised for good performance on large matrices, not small ones.
>
> Does anyone have any suggestions as to the most efficient way to solve
> this problem? Extreme accuracy is not required. 4x4 is probably small
> enough that there's an analytic solution :).
>
> −−
> Mark Mackey
> "The determined Real Programmer can write Fortran programs in any language."
> − "Real Programmers don't use Pascal"

The secular equation for the eigenvalues of a 4x4 matrix is a quartic polynomial. The quartic polynomial can be solved in closed form with radicals. The solution is given in Abramowitz & Stegun, "Handbook of Mathematical Functions ".

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"For there was never yet philosopher that could endure the
toothache patiently."
−− Wm. Shakespeare, Much Ado about Nothing. Act v. Sc. 1.