What Does a Floating-Point Error-Analyst Do?

- Moderately over-estimate errors in
  scientific and engineering computations.
- Find ways to attenuate intolerably big errors.

What Have I Done *Recently* ?

A Case Study:

Undamped elastic structures vibrate in *Modes* at *Frequencies* determined by a matrix eigenproblem " $A \cdot \mathbf{x} = \lambda \cdot H \cdot \mathbf{x}$ " in which *Stiffness* matrix A is symmetric, *Inertia* matrix H is symmetric and positive definite, nonzero *Eigenvector* **x** represents a mode of vibration at a frequency $\sqrt{\lambda}$ determined by an *Eigenvalue* λ.

Given a structure's n-by-n matrices A and H, structural engineers try any of many programs to compute all n eigenvalues and eigenvectors.

Shortcomings Structural Engineers Don't Know About Yet:

- All their methods are susceptible to rare roundoff-induced errors far bigger than their data deserve but unlikely to be noticed until too late.
- Iterative methods have been in use for four decades with no proof of convergence; and some can produce awful results for innocuous data.

Recently I found remedies for all those shortcomings except these:

Two Unnecessary Impediments:

Almost all programming languages persist in harmful practices inherited from 1950's superstitions about floating-point arithmetic. And the accompanying debuggers leave floating-point software practically impossible for engineers using it to debug.

<www.cs.berkeley.edu/~wkahan/…>

See My Web Page for More Details about …

Floating-Point Misconceptions Enshrined in Programming Languages:

- "How JAVA's Floating-Point Hurts Everyone Everywhere" <…/JAVAhurt.pdf >
- "Matlab's Loss is Nobody's Gain" <…/MxMulEps.pdf >

Why Debugging Numerical Software is Practically Impossible:

- "Why is Floating-Point Computation so Hard to Debug when it Goes Wrong?" <…/WrongR.pdf >
- "Why can I Debug some Numerical Programs that You Can't" <…/Stnfrd50.pdf >
- "How Futile are Mindless Assessments of Roundoff in Floating-Point Computation?" <…/Mindless.pdf >
- "Marketing versus Mathematics …" <…/MktgMath.pdf >
- "Needed Remedies for the Undebuggability of Large Scale Floating-Point Computations in Science & Engineering" <…/7Oct09.pdf>

The Structural Engineers' Eigenvalue Problem:

- "Back to the Future of Undebuggable Floating-Point Computation in Science and Engineering" <…/BASCD08K.pdf >
- "Refining the General Symmetric Definite Eigenproblem" *WORK STILL BEING WRITTEN UP* <…/Math128/GnSymEig.pdf>

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