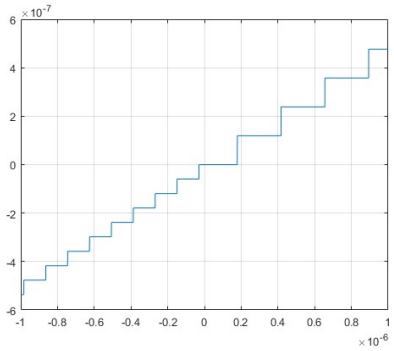
Numerical Acoustics - Spring

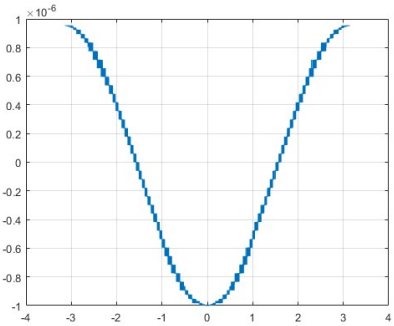
Exercise 2: Rounding errors

The purpose of this exercise is examining cases where the finite precision representation in a computer can have an impact on the calculations and observe that it is often possible to reduce such impact.

- Represent the following expressions in a short range around the proposed value and observe the results. Use single precision (32 bits) floating-point variables to make the observed effects more obvious (use Matlab function *single* for setting up the variables).
- When two variables are involved, they should be very close to provoke error (2nd and 3rd cases). Vary one of them and define the other by adding a very small constant (e.g., 10^{-6}).
- Note that the result of this exercise may change depending on which computer you run it!

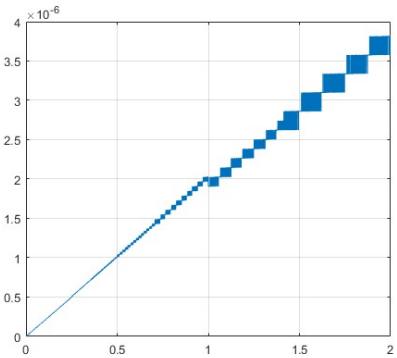
$\sqrt{x+1}-1, \qquad x \approx 0$





$\sin(x) - \sin(y), \qquad x \approx y$

$x^2 - y^2, \qquad x \approx y$



- Rewrite the expressions so that the errors are reduced. Is it possible to eliminate rounding errors completely by rewriting?
- Prepare for a short explanation to your classmates. The exercise is run in groups.

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$$\sqrt{x+1}-1 \quad \Big| \cdot \frac{\sqrt{x+1}+1}{\sqrt{x+1}+1}$$

$$\frac{(\sqrt{x+1}-1)(\sqrt{x+1}+1)}{\sqrt{x+1}+1}$$

$$\frac{x+1+\sqrt{x+1}-\sqrt{x+1}-1}{\sqrt{x+1}+1}$$

$$\sin(x)-\sin(y)$$

$$\Rightarrow \quad 2\cos\left(\frac{x+y}{2}\right)\sin\left(\frac{x-y}{2}\right)$$