These animations originate as .gif generated using Mathematica.

**FrameNumberMovies:**
These movies tag each frame with a frame number to facilitate collecting data vs. time or other key parameter.

**HelmholtzFieldVsSep:** Displays on axis field plot for a coil pair with the coil pair separation as a parameter

**widthOscCompareFrmNumber**

**Fourier:** See the ‘detailed’ animations in the Fourier series collections.

![Width Oscillations of a Gaussian Probability Distribution](image)

An initial Gaussian probability distribution constructed as a superposition of QHO eigenstates has the property that its width squared oscillates between its initial value, \( w_0^2 \) and \( w_0^{-2} \) (the width of the ground state distribution is 1) at twice the natural frequency of the oscillator.

\[
width^2 = A + B \cos(2 \omega_0 t)
\]

**QuantumHO**

A collection of mixed state oscillator probability density movies designed to illustrate classical behavior in the correspondence limit and to examine \( \langle x(t) \rangle \). The expansion coefficients necessary
for these movies were computed in closed form, but it is just as effective and probably more instructive to setup the overlap integrals and let Mathematica complete the process.

**Correspondence OscillatorCompFinal:** This movie illustrates that a Gaussian probability distribution with the same width as the ground state displaced by \( d \) (from \( x = 0 \)) will oscillate with constant width at the natural frequency. If a wider (narrower) distribution is chosen, width oscillations as well as harmonic translation occur (see the frame number movie above).

![QHO Movie Correspondence Limit](image)

**Correspondence OscillatorNarrow:** Just the blue case from above.

**SimpleCorrespOsc:** the best example

**osc0plus1mov:** Equal mix of states 0 and 1 displaying \( \langle x \rangle \). The turning point for \( \langle x \rangle \) is accidentally at a peak in the probability density.

**osc0ut23ExpX:** Equal mix of states 2 and 3 displaying \( \langle x \rangle \). The turning point for \( \langle x \rangle \) is NOT accidentally at a peak in the probability density.

**osc03ExpX:** Equal mix of states 0 and 3 displaying \( \langle x \rangle \). Shows that \( \langle x \rangle \) does not oscillate. Collection is to show that \( x \) links \( n \) to \( n \pm 1 \) only.

**oscMovv11StateWith01Mix2:** 01 Mix with a ‘correspondence’ state to illustrate that \( \langle x \rangle \) for all oscillates at the natural frequency.

**WidthOscCompareHalfNoFrm; widthOscCompareTwiceNoFrm:** Width oscillations of Gaussians with width \( w \) times that of the ground state probability distribution
oscCorrWplusnm “Correspondence” state and a mn mixed state to demonstrate that the oscillation frequency is the same.

Fourier:

A set of animations illustrating a Fourier series converging to a discontinuous function in the mean using the -1 to +1 square wave. The discontinuity has magnitude 2. In the ‘detailed’ versions, the approximate 9% overshoot can be seen.

A set of animations illustrating a Fourier series converging uniformly to a continuous function using the -1 to +1 anti-symmetric triangle wave wave. The ‘detailed’ versions suggest that the convergence is uniform.

The posted animations are based on the ones created by Prof. Nearing at the University of Miami. http://www.physics.miami.edu/~nearing/mathmethods/

* Little known fact:

The Gibbs phenomenon was discovered by Albert Michelson while he was summing a Fourier series with coefficients for a periodic function that he measured using an optical-mechanical system. Michelson was a U S Naval Academy midshipman and instructor. One of his speed-of-light measurements was made at the academy.

Michelson:

MichelsonEqualL; MichelsonGreen2; MichelsonSodium: Michelson ring patterns as the apparatus is adjusted through the equal path length condition. If an adjustment toward the equal path condition is made, the rings move inward, and the ring widths increase. Both behaviors can be used as guides to reach the equal-path-length condition necessary to observe white light fringes.
The B/W movies are DensityPlots; the color movies are ArrayPlots.

\[
michelsonGreen = \text{Table}[\text{ArrayPlot}[\text{Table}[\text{IntegerPart}[128 * (1 + \cos(d - d (i^2 + j^2)/2^{15})]],[i,-127,128],[j,-127,128]],\text{ColorRules} \rightarrow \text{colorArrayInt}, \text{DisplayFunction} \rightarrow \text{Identity}],[d,-50,50,0.5]]
\]

**MichelsonFakedWashouts**: Weak representations of the sodium washouts. The sodium washouts are dramatic because the lines are closely spaced so the washout persists for many cycles. Memory limitations required that a 5% difference be used for these examples.

**PlaneWaveAndPackets**: free-particle packets

**WavePacketSpreadCompare**: The spreading of three translating wave packets with different initial widths is compared. The narrowest packet displays strong chirping after spreading.

**WavePacketRI**: Plots the real and imaginary parts of a wave packet. Comparison shows that the parts behave similarly. This observation justifies plotting the real part only. *** This movie also shows the dramatic difference between the group and phase velocities for free particle packets.
MultiSourceSuperposition:

A collection of animations based on a notebook prepared by Steve Montgomery. The waves are modeled as cylindrical and the amplitude decrease with distance is included.

The movies (f1f1) have two sources in phase at the same frequency with either a wide or close separation. Movies with f1f2 in the name show the behavior for sources with different frequencies.

The enclosed IntensityMultiSource plots are of intensity rather than net wave amplitude. The collection includes a three source animation in which secondary lobes are visible. The four source examples show the secondary lobes pairs. The four source examples include in phase, $\pi/6$, $\pi/2$ and end-fire source to source relative phases.

Six source end-fire. The distance dependence was altered to $1/\sqrt{1 + \text{distance}}$ for the amplitude to suppress the divergences near the sources. The plots where made using ArrayPlot to force a value to color level mapping.
Animations for Physics and Math Methods Sites

http://www.physics.miami.edu/~nearing/mathmethods/  Prof. Nearing animates series expansions and adds some drumhead mode movies. The Fourier series movie set is well suited to a discussion of the Gibbs phenomenon.