OPTI 512 Homework 1 Due: September 9, 2020

1. Show that $cos3x = cos^3x - 3cosxsin^2x$. There are two ways to go here, the hard way is to represent $cos3x = cos(2x + x)$ and then use you angle-sum trig identities to expand out, and then repeat that process for the $cos2x$ and $sin2x$ terms that appear. Ugh. The easy way is to represent $cos3x$ as a complex exponential and use the fact that $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$. Do this the easy way.

2. Given a function defined as

$$f(x) = \begin{cases} \left(\frac{x}{2} + 1\right) cos\left(\frac{\pi x}{2}\right), & -2 \le x < 1 \\ 0, & otherwise \end{cases}$$

   (a) Plot $f(x)$.

   (b) Plot $f(x - 3)$.

   (c) Plot $f(-x)$.

   (d) Plot $f(3 - x)$.

3. Any function $f(x)$ can be split into a combination of an even function $f_e(x)$ and an odd function $f_o(x)$ such that $f(x) = f_e(x) + f_o(x)$. For the function definition in the previous problem, plot $f_e(x)$ and $f_o(x)$.

4. The images below show 2D sinusoidal patterns. What are the spatial frequencies ξ_o of these patterns in the horizontal direction if each image has a width of 50 mm? Which pattern has the higher spatial frequency. Be sure to include the units.