Winter College on Optics in Imaging Science

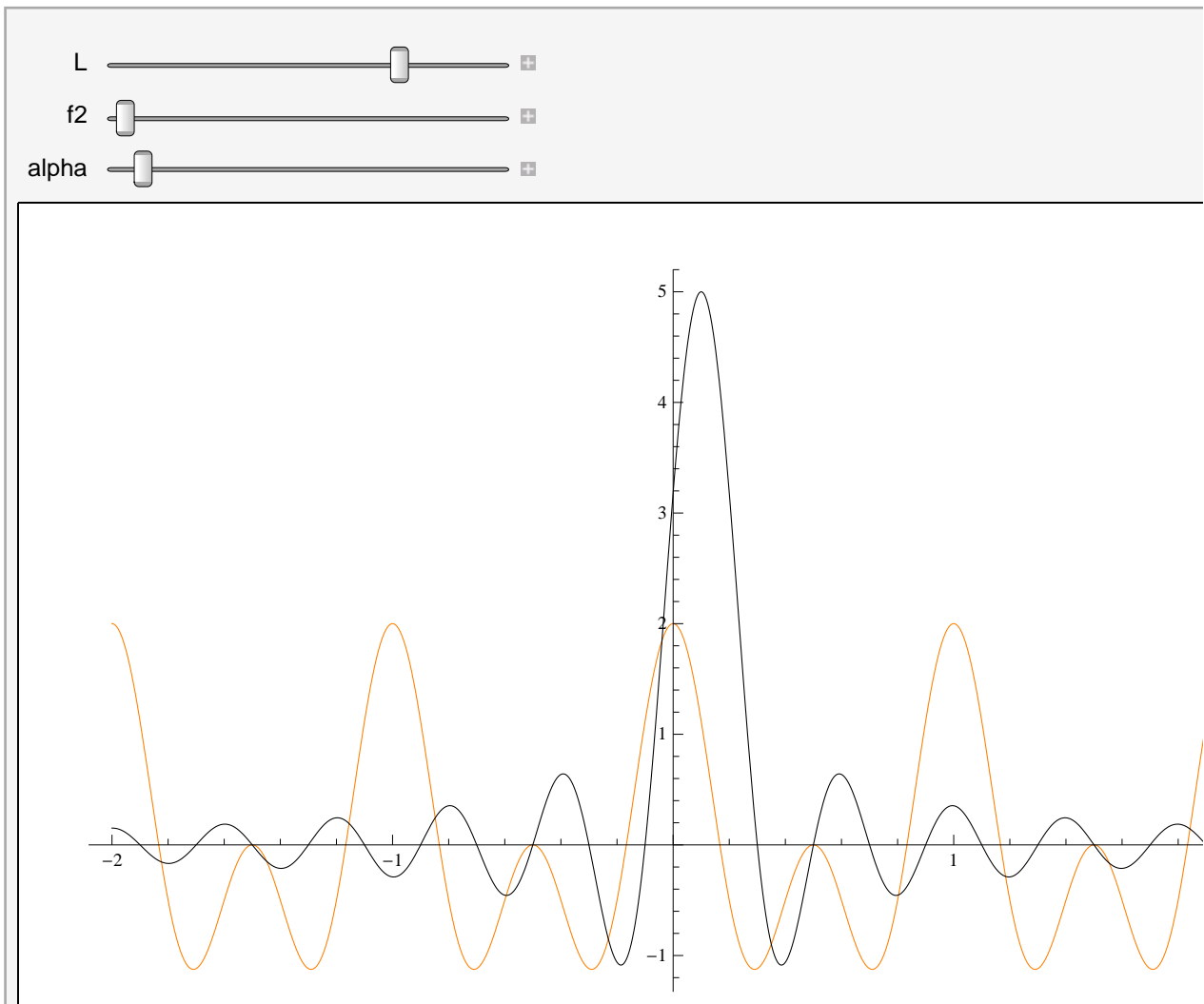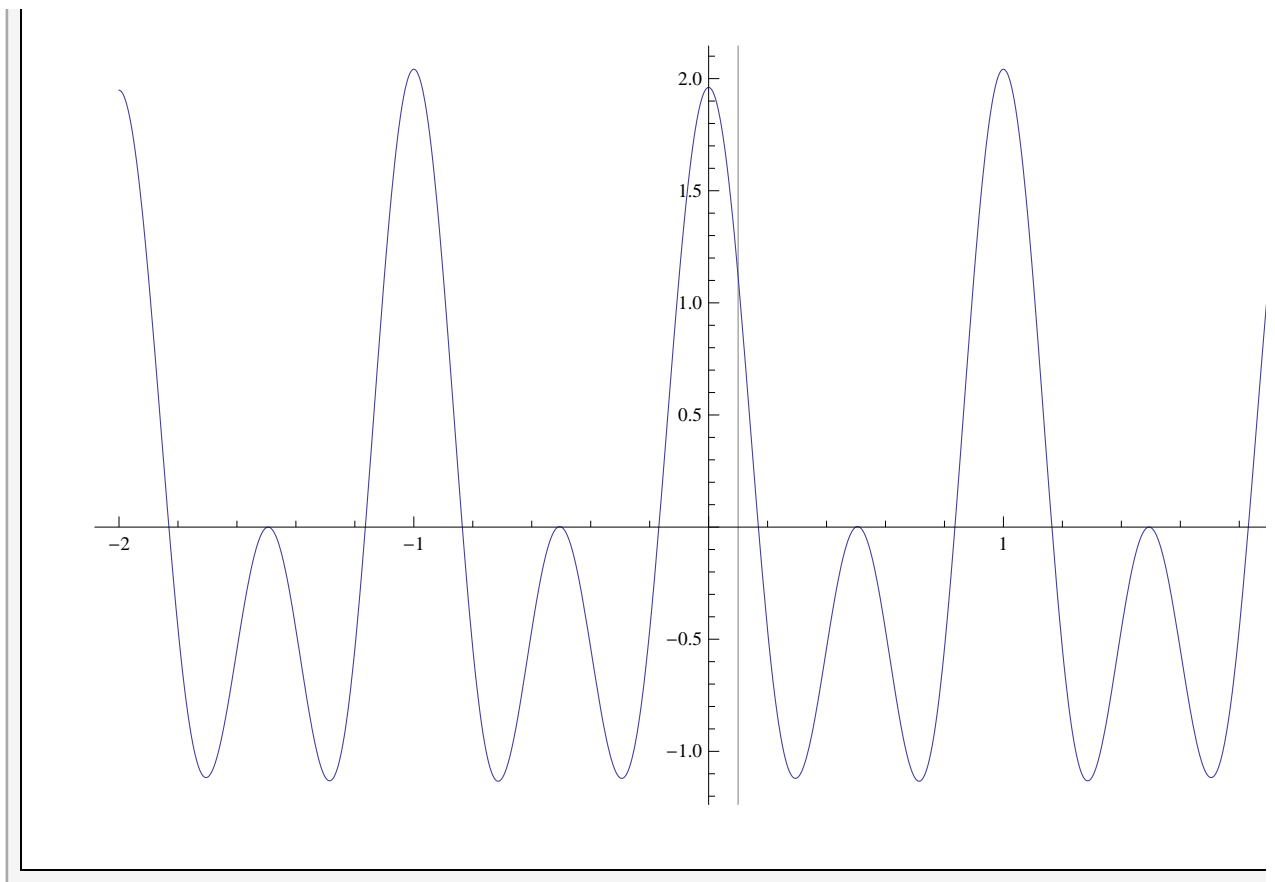## *31 January – 11 February, 2011*

Convolution + Example

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```
Manipulate[

  Show[GraphicsArray[{{Plot[{(Cos[2 π f1D X] + Cos[2 π f2 X]), (Sin[2 π (L f1D) (X - alpha)] / (π (X - alpha)))},
        {X, -2, 2}, PlotRange → All, PlotStyle → {Orange, Black}]},
     {Plot[ConvCosineWithSinc[x, L, f1D, f2, Wd, NnD], {x, -2, 2}, PlotRange → All,
       ImageSize → Large, GridLines → {{alpha}, None}]}}]],

  {L, 1, 3, 0.25}, {f2, 2, 4, .1}, {alpha, 0, 2}, SaveDefinitions → True]
```

```
Trap[ff[t], be_, ed_, Num_] := Module[{x}, (

    StepSz = (ed - be) / Num;
    StepSz
    ─────── (ff[ed] + ff[be] + 2 * Sum[ff[x], {x, be + StepSz, ed - StepSz, StepSz}])
      2

)]

Clear[f]
```
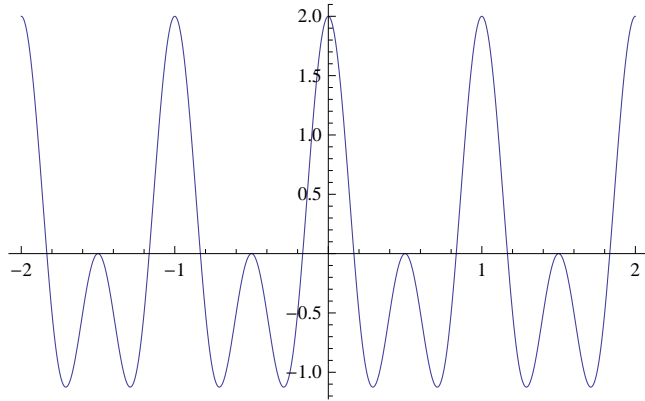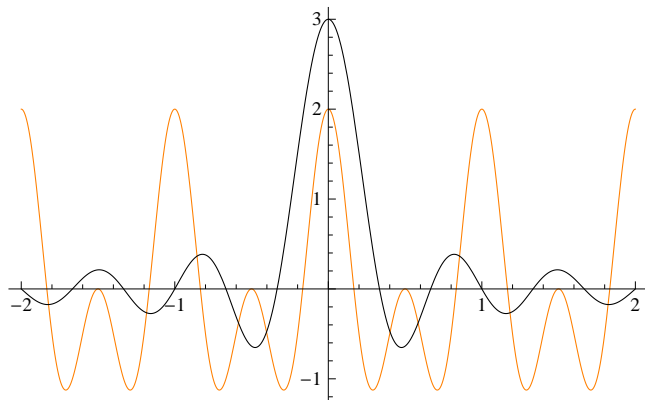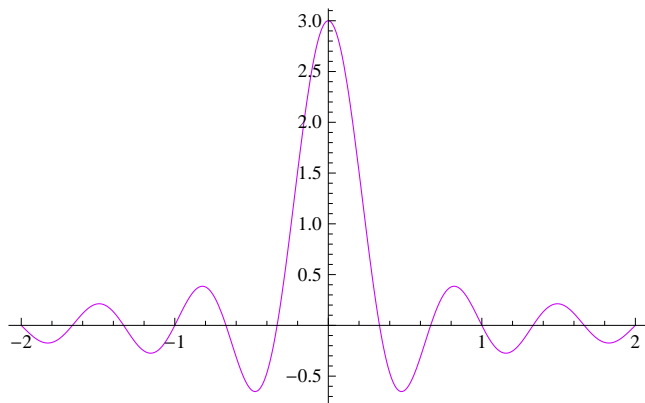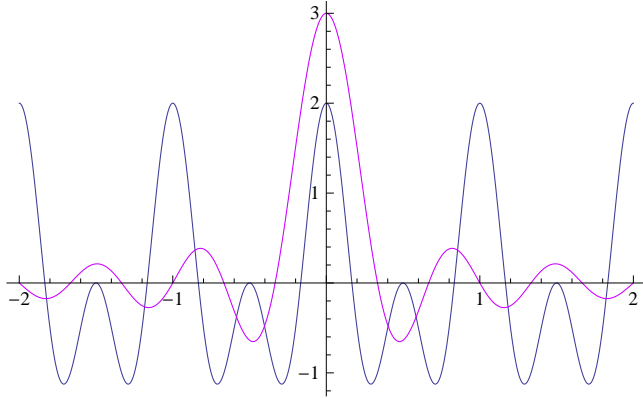
p1 = Plot[(Cos[2 π f1 X] + Cos[2 π f2 X]) /. {f1 → 1, f2 → 2}, {X, -2, 2}, PlotRange → All]

p2 = Plot$\left[\left(\dfrac{\text{Sin}[2 \pi (1.5 \, \text{f1}) (X)]}{\pi (X)}\right)\right]$ /. {f1 → 1, f2 → 2},

   {X, -2, 2}, PlotRange → All, PlotStyle → Hue[0.8]$\Big]$

```
Show[p1, p2]
```


$$\text{NIntegrate}\left[\left(\frac{\text{Sin}[2\,\pi\,(1.5\,f1)\,(X)]}{\pi\,(X)}\right)(\text{Cos}[2\,\pi\,f1\,X]+\text{Cos}[2\,\pi\,f2\,X])\,/.\,\{f1\to1,\,f2\to2\},\,\{X,\,-.1,\,.1\}\right]$$

```
0.973411
```

```
(Cos[2 π f1 X] + Cos[2 π f2 X]) /. {f1 → 1, f2 → 2}
```

```
f[x_, f1_, f2_] :=
```
$$\text{NIntegrate}\left[(\text{Cos}[2\,\pi\,f1\,X]+\text{Cos}[2\,\pi\,f2\,X])*\left(\frac{\text{Sin}[2\,\pi\,(L\,f1)\,(x-X)]}{\pi\,(x-X)}\right),\,\{X,\,-10,\,10\}\right]$$

```
ConvWithPixel[x_, γ_, PA_, PB_, L_, W_, Num_] :=
   Trap[ff[t], -W, W, Num] /. ff[σ_] → (InpFunc[σ, PA + L, PB + L, L] * PixelFunction[x - σ, γ]);
```

```
ConvCosineWithSinc[x_, L_, f1_, f2_, W_, Num_] :=
```
$$\text{Trap}[ff[t],\,-W,\,W,\,Num]\,/.\,ff[\sigma\_]\to\left((\text{Cos}[2\,\pi\,f1\,\sigma]+\text{Cos}[2\,\pi\,f2\,\sigma])*\left(\frac{\text{Sin}[2\,\pi\,(L\,f1)\,(x-\sigma)]}{\pi\,(x-\sigma)}\right)\right);$$
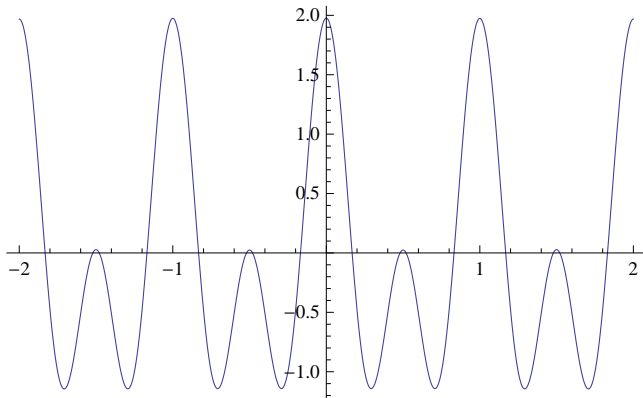
```
f1D = 1;
f2D = 2;
Ld = 1.5;
NnD = 200;
Wd = 4;
ConvCosineWithSinc[x, Ld, f1D, f2D, Wd, NnD] /. x → 1.01
```
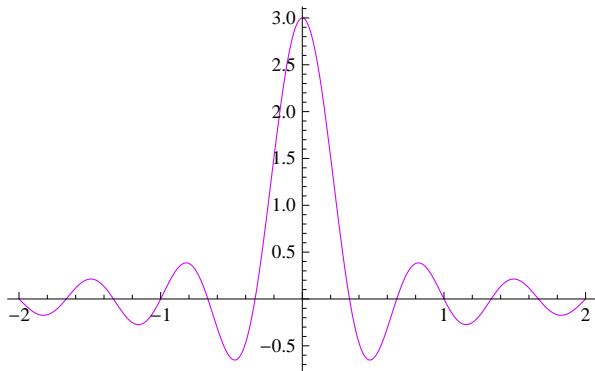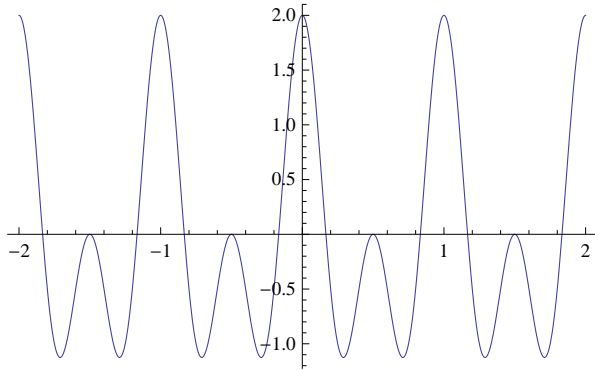
```
1.00662
```

```
Plot[ConvCosineWithSinc[x, 2 Ld, f1D, f2D, Wd, NnD], {x, -2, 2}, PlotRange → All]
```

Show[GraphicsArray[{{p1}, {p2}}]]

GridLines