4.18

Show that the 1-D convolution theorem also holds for discrete variables:

While letting the DFT of be , respectively.

The functions are sampled with sample points.

Proof 1

From the translation property we know that

And so, we showed the first part of the convolution theorem- .

Now we want to show that

Proof 2

From the translation property we know that

And so, we showed the second part of the convolution theorem- .

4.20

Use the sifting property of the 2-D impulse to show that convolution of a 2-D continuous function, , with an impulse shifts the function so that its origin is located at the location of the impulse.

The sifting property (4-55):

Show:

Proof

Using the sifting property, with the origin located at we get that

From definition is non-zero only when , we can deduce the dirac delta function’s symmetry- . The same logic applies for multi-variable dirac delta functions.

Therefore,