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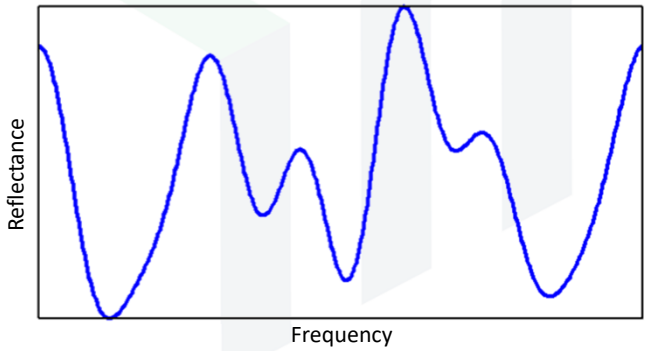
Computational Science:
Computational Methods in Engineering

The Rectangle Algorithm

Goal of the Algorithm

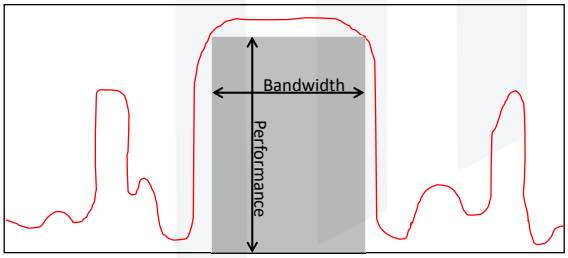
Suppose a broadband reflector is to be designed. An initial design is constructed, simulated and the reflectance calculated. Using a single quantity, what is the performance of this preliminary design?



A Very Common Merit Function

In electromagnetics, usually performance (i.e. reflectance here) is to be maximized over some bandwidth.

$$\text{MF} = \left(\text{Bandwidth}\right) \times \left(\text{Performance}\right)$$



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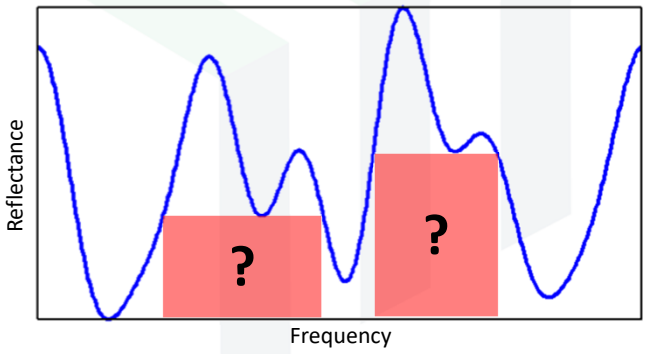
The Rectangle Algorithm

One possible merit function can be calculated by finding the biggest rectangle that fits under the reflectance curve. But…which rectangle is biggest?



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Steps in the Rectangle Algorithm

- Step 0 – Decide on a merit function.
- Step 1 – Simulate the spectrum of the device.
- Step 2 – Loop over all points in spectra.
  i. Seek left to place left edge of rectangle.
  ii. Seek right to place right edge of rectangle.
  iii. Calculate merit function.
- Step 3 – Overall merit function is the area of the largest rectangle found in Step 2.

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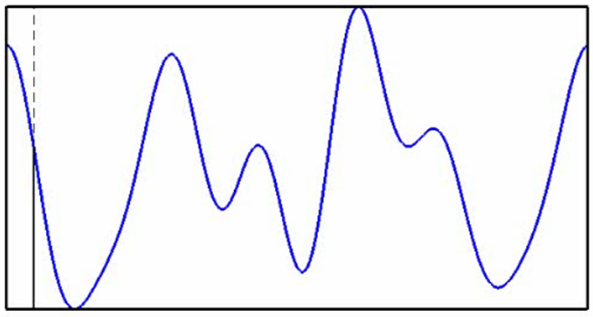
Animation of Rectangle Construction



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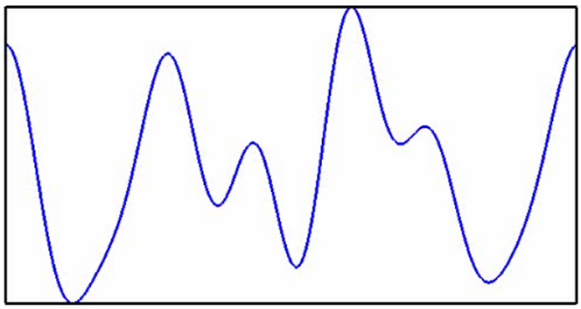
Animation of the Rectangle Algorithm (1 of 3)

$$\text{MF} = w \cdot h$$



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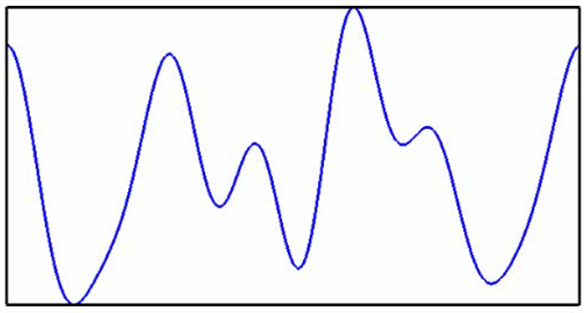
Animation of the Rectangle Algorithm (2 of 3)

$$\text{MF} = \log(1+w) \cdot h^3$$



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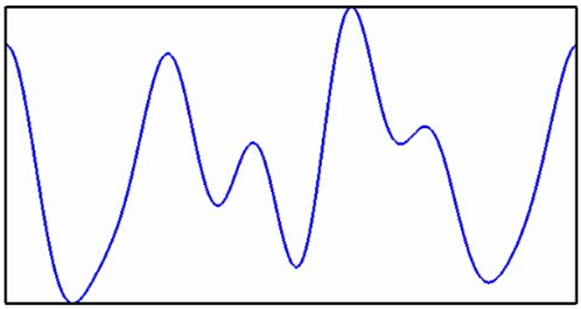
Animation of the Rectangle Algorithm (3 of 3)

$$\mathrm{MF} = w^3 \cdot \log\left(1 + h\right)$$



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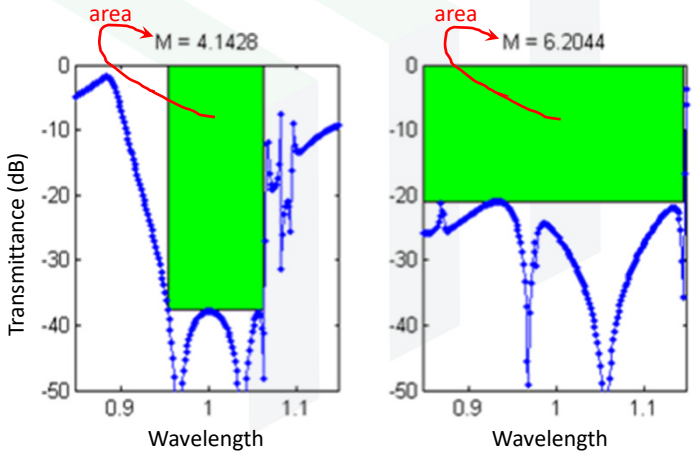
An Example Merit Function

Suppose it is desired to minimize transmission through a device where the application requires it to be broadband. You need both minimum transmission and wide bandwidth.

$$M \sim |T| \cdot \mathrm{BW}$$



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