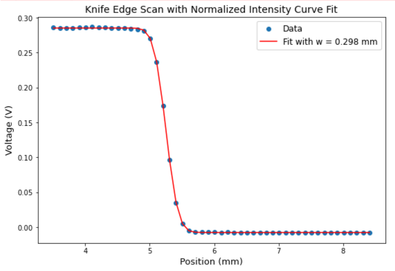
In [44]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from scipy.optimize import curve_fit
from scipy import special


df = pd.read_csv('knife.csv')

x = df.iloc[:,0]
y = df.iloc[:,1]

def fit(x, a, w, x0, c):
    return a * special.erf(np.sqrt(2) * ((x - x0) / w)) + c # scale and shift parameters added
# because model assumes curve goes from 0 to 1 and is centered at 0 but thats not the case
# a is amplitude to scale vertically, x0 is the center of the curve (the x value for when we reach
# center of y vals) c is to shift the curve vertically

# intial guess
initial = [0.1, 0.23, 5.3, 0.1 ]

params, cov = curve_fit(fit, x, y, p0=initial_guess)

Y = fit(x, *params)

w_fit = params[1]

plt.figure(figsize=(9,6))
plt.scatter(x, y, label='Data')
plt.plot(x, Y, color='red', label="Fit with w = 0.298 mm")
plt.xlabel('Position (mm)', size=13)
plt.ylabel('Voltage (V)', size=13)
plt.title('Knife Edge Scan with Normalized Intensity Curve Fit', size=14)
plt.legend(fontsize=12)
plt.savefig('knife_edge.pdf', type='pdf')

plt.show()


print(f"Fitted parameters: a={params[0]:.3f}, w={params[1]:.3f}, x0={params[2]:.3f}, c={params[3]:.3f}")
```

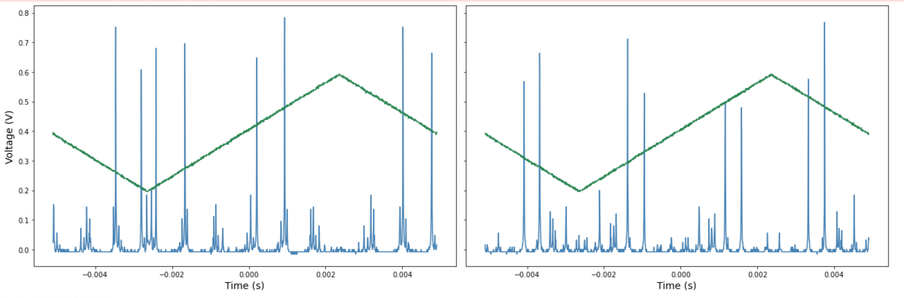
```
/var/folders/x9/rf4c011x52vfcxfkn1q6gjy80000gn/T/ipykernel_48841/4187570023.py:35: MatplotlibDeprecationWarning: savefig() got unexpected keyword argument "type" which is no longer supported as of 3.3 and will become an error in 3.6
  plt.savefig('knife_edge.pdf', type='pdf')
```




```
Fitted parameters: a=-0.146, w=0.298, x0=5.252, c=0.139
```

In [91]:
```
# cavity scan plots

import pandas as pd
import matplotlib.pyplot as plt

f = pd.read_csv('cavity_22.5.txt')

x = f.iloc[:,0] # scan data
y = f.iloc[:,1] # scan data
x_func = f.iloc[:,2] # triangle waveform
y_func = f.iloc[:,3] / 5 # triangle waveform

f1 = pd.read_csv('cavity_6.5.txt')

x1 = f1.iloc[:,0] # scan data
y1 = f1.iloc[:,1] # scan data
x_func1 = f1.iloc[:,2] # triangle waveform
y_func1 = f1.iloc[:,3] / 5 # triangle waveform


fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(18,6), sharey=True)

ax1.plot(x, y, color='steelblue')
ax1.plot(x_func, y_func, color='seagreen')
ax1.set_xlabel('Time (s)', size=14)
ax1.set_ylabel('Voltage (V)', size=14)


ax2.plot(x1, y1, color='steelblue')
ax2.plot(x_func1, y_func1, color='seagreen')
ax2.set_xlabel('Time (s)', size=14)

plt.savefig('cavityscan.pdf', type='pdf')

plt.tight_layout()
plt.show()

print(np.mean(y))
print(np.mean(y1))
```

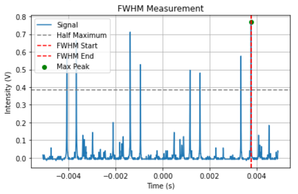
```
/var/folders/x9/rf4c011x52vfcxfkn1q6gjy80000gn/T/ipykernel_48841/1023033853.py:33: MatplotlibDeprecationWarning: savefig() got unexpected keyword argument "type" which is no longer supported as of 3.3 and will become an error in 3.6
  plt.savefig('cavityscan.pdf', type='pdf')
```




```
0.011233293317327184
0.008329731892757338
```

In [9]:
```
import numpy as np
import matplotlib.pyplot as plt
from scipy.signal import find_peaks
import pandas as pd

# Load your data
d = pd.read_csv('cavity_6.5.txt')  # Replace with your filename
x = d.iloc[:, 0]  # Time
y = d.iloc[:, 1]  # Voltage or intensity

# Find peaks
peaks, _ = find_peaks(y)
if len(peaks) == 0:
    print("No peaks found.")
    exit()

# Get max peak
max_peak_idx = peaks[np.argmax(y[peaks])]
max_peak_height = y[max_peak_idx]
half_max = max_peak_height / 2

# Find the FWHM boundaries
# Go left from max peak
left_idx = max_peak_idx
while left_idx > 0 and y[left_idx] > half_max:
    left_idx -= 1

# Linear interpolate for more accurate crossing point
x1, x2 = x[left_idx], x[left_idx + 1]
y1, y2 = y[left_idx], y[left_idx + 1]
left_cross = x1 + (half_max - y1) * (x2 - x1) / (y2 - y1)

# Go right from max peak
right_idx = max_peak_idx
while right_idx < len(y) - 1 and y[right_idx] > half_max:
    right_idx += 1

x1, x2 = x[right_idx - 1], x[right_idx]
y1, y2 = y[right_idx - 1], y[right_idx]
right_cross = x1 + (half_max - y1) * (x2 - x1) / (y2 - y1)

fwhm = right_cross - left_cross
print(f"FWHM of max peak: {fwhm:.6f} s")

# Plot for visual confirmation
plt.plot(x, y, label='Signal')
plt.axhline(half_max, color='gray', linestyle='--', label='Half Maximum')
plt.axvline(left_cross, color='red', linestyle='--', label='FWHM Start')
plt.axvline(right_cross, color='red', linestyle='--', label='FWHM End')
plt.scatter(x[max_peak_idx], max_peak_height, color='green', label='Max Peak')
plt.legend()
plt.xlabel("Time (s)")
plt.ylabel("Intensity (V)")
plt.title("FWHM Measurement")
plt.grid()
plt.tight_layout()
plt.show()


print(np.max(y))
```

```
FWHM of max peak: 0.000010 s
```




```
2211
```

In [ ]: