

```
In [1]: import matplotlib.pyplot as plt
import numpy as np
from scipy import signal
from satellite_pipeline import SatellitePipeline

pipeline = SatellitePipeline()
```

```
In [2]: import ipywidgets as widgets
from IPython.display import display

files = pipeline.get_file_list()
file_dropdown = widgets.Dropdown(options=files, description='File:')
display(file_dropdown)

Dropdown(description='File:', options=('lkuns_pf.wav', 'aaltol.wav', 'aausat_4.wav', 'aisat.wav', 'aistechsats3...'))
```

```
In [3]: filename = file_dropdown.value
sat_id = pipeline.identify_satellite(filename)
filename
```

```
Out[3]: 'lkuns_pf.wav'
```

```
In [4]: # Load and Plot
fs, data = pipeline.load_signal(filename)
duration = len(data) / fs

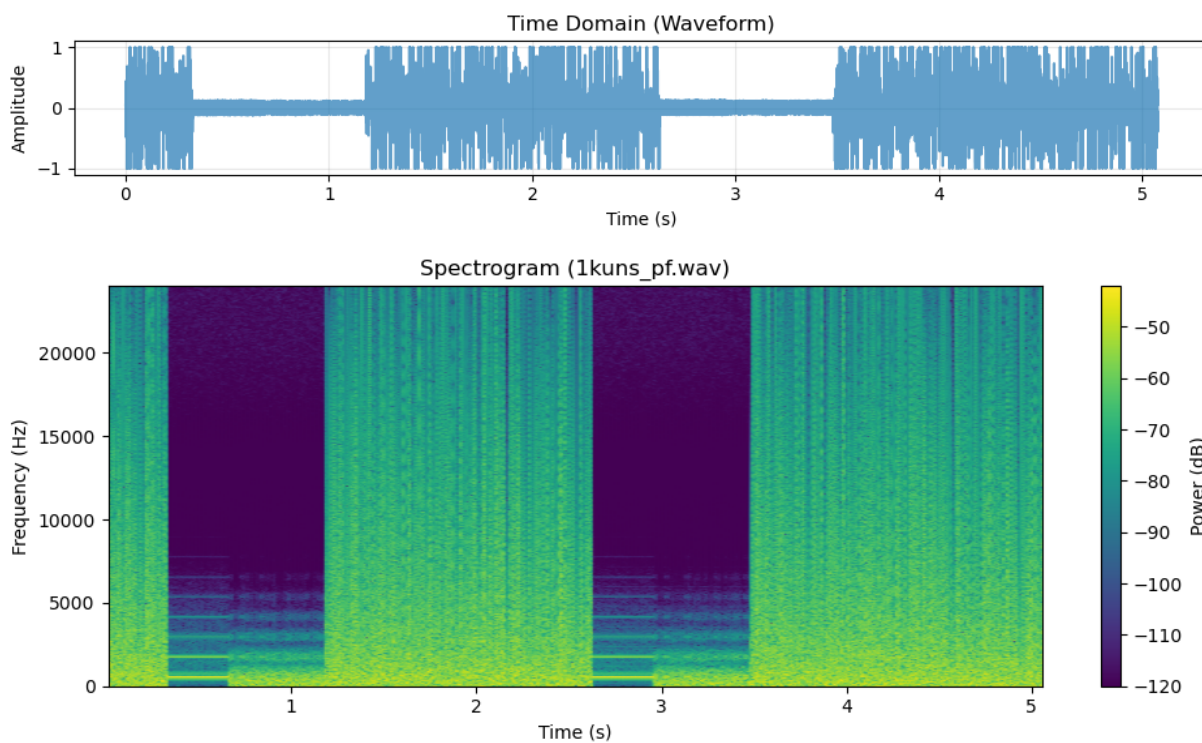
# 1. Time Domain
fig_time, ax_time = plt.subplots(figsize=(10, 2))
t = np.arange(len(data)) / fs
ax_time.plot(t, data, alpha=0.7)
ax_time.set_title("Time Domain (Waveform)")
ax_time.set_xlabel("Time (s)")
ax_time.set_ylabel("Amplitude")
ax_time.grid(True, alpha=0.3)
plt.tight_layout()

# 2. Frequency Domain (Spectrogram)
fig_spec, ax_spec = plt.subplots(figsize=(10, 4))
# nperseg affects frequency resolution. Higher = finer freq, coarser time.
f, t_spec, Sxx = signal.spectrogram(data, fs, nperseg=1024, noverlap=512)
Sxx_log = 10 * np.log10(Sxx + 1e-12)

c = ax_spec.pcolormesh(t_spec, f, Sxx_log, shading='gouraud', cmap='viridis')
ax_spec.set_title(f"Spectrogram ({filename})")
ax_spec.set_ylabel("Frequency (Hz)")
ax_spec.set_xlabel("Time (s)")
plt.colorbar(c, ax=ax_spec, label='Power (dB)')
plt.tight_layout()

# Educational Text based on signal
obs_text = ""
if "ao73" in filename:
    obs_text = "Notice the continuous narrow line? That's the **BPSK** carrier"
```

```
elif "gomx" in filename:
    obs_text = "Notice the wider bursts? That's high-speed **9k6 FSK**. It l
elif "lilacsat" in filename:
    obs_text = "LilacSat uses **BPSK**. If it's the image file, you might se
```



```
In [5]: result = pipeline.decode(filename, sat_id)
```

Running decoder: pixi run gr_satellites 1KUNS-PF --wavfile satellite-recordings/1kuns_pf.wav

```
In [6]: result
```

```

Out[6]: {'success': True,
        'satellite': '1KUNS-PF',
        'stdout': '-> Packet from 1k2 FSK downlink\nContainer: \n      csp_header =
Container: \n      priority = 2\n      source = 1\n      destination
= 9\n      destination_port = 10\n      source_port = 37\n      reser
ved = 0\n      fragmentation = False\n      hmac = False\n      xtea
= False\n      rdp = False\n      crc = False\n      beacon_counter = 427
4\n      solar_panel_voltage = ListContainer: \n      2448.0\n      244
8.0\n      2432.0\n      eps_temp = ListContainer: \n      1.0\n
3.0\n      2.0\n      2.0\n      eps_boot_cause = 7\n      eps_batt_mode =
3\n      solar_panel_current = 0.0\n      system_input_current = 80.0\n      batt
ery_voltage = 8262.0\n      radio_PA_temp = 4.0\n      tx_count = 45584\n      rx
_count = 0\n      obc_temp = ListContainer: \n      1.0\n      1.0\n      a
ng_velocity_mag = 10\n      magnetometer = ListContainer: \n      288.0\n
0.0\n      0.0\n      main_axis_of_rot = 89\n-> Packet from 1k2 FSK downlin
k\nContainer: \n      csp_header = Container: \n      priority = 2\n
source = 1\n      destination = 9\n      destination_port = 10\n
source_port = 37\n      reserved = 0\n      fragmentation = False\n
hmac = False\n      xtea = False\n      rdp = False\n      crc = Fals
e\n      beacon_counter = 4275\n      solar_panel_voltage = ListContainer: \n
2256.0\n      2256.0\n      2240.0\n      eps_temp = ListContainer: \n
0.0\n      3.0\n      2.0\n      2.0\n      eps_boot_cause = 7\n      eps
_batt_mode = 4\n      solar_panel_current = 0.0\n      system_input_current = 8
0.0\n      battery_voltage = 8296.0\n      radio_PA_temp = 4.0\n      tx_count =
45840\n      rx_count = 0\n      obc_temp = ListContainer: \n      1.0\n
1.0\n      ang_velocity_mag = 10\n      magnetometer = ListContainer: \n
318.0\n      0.0\n      0.0\n      main_axis_of_rot = 89\n',
        'stderr': ''}

```

```
In [7]: print(result['stdout'])
```

-> Packet from 1k2 FSK downlink

Container:

```
csp_header = Container:
  priority = 2
  source = 1
  destination = 9
  destination_port = 10
  source_port = 37
  reserved = 0
  fragmentation = False
  hmac = False
  xtea = False
  rdp = False
  crc = False
beacon_counter = 4274
solar_panel_voltage = ListContainer:
  2448.0
  2448.0
  2432.0
eps_temp = ListContainer:
  1.0
  3.0
  2.0
  2.0
eps_boot_cause = 7
eps_batt_mode = 3
solar_panel_current = 0.0
system_input_current = 80.0
battery_voltage = 8262.0
radio_PA_temp = 4.0
tx_count = 45584
rx_count = 0
obc_temp = ListContainer:
  1.0
  1.0
ang_velocity_mag = 10
magnetometer = ListContainer:
  288.0
  0.0
  0.0
main_axis_of_rot = 89
```

-> Packet from 1k2 FSK downlink

Container:

```
csp_header = Container:
  priority = 2
  source = 1
  destination = 9
  destination_port = 10
  source_port = 37
  reserved = 0
  fragmentation = False
  hmac = False
  xtea = False
  rdp = False
  crc = False
beacon_counter = 4275
```

```
solar_panel_voltage = ListContainer:  
    2256.0  
    2256.0  
    2240.0  
eps_temp = ListContainer:  
    0.0  
    3.0  
    2.0  
    2.0  
eps_boot_cause = 7  
eps_batt_mode = 4  
solar_panel_current = 0.0  
system_input_current = 80.0  
battery_voltage = 8296.0  
radio_PA_temp = 4.0  
tx_count = 45840  
rx_count = 0  
obc_temp = ListContainer:  
    1.0  
    1.0  
ang_velocity_mag = 10  
magnetometer = ListContainer:  
    318.0  
    0.0  
    0.0  
main_axis_of_rot = 89
```

In []: