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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=('1kuns_pf.wav', 'aalto1.wav', 'aausat_4.wav', 'aisat.wav', 'aistechsat3...'))

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

Out[3]: '1kuns_pf.wav'

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

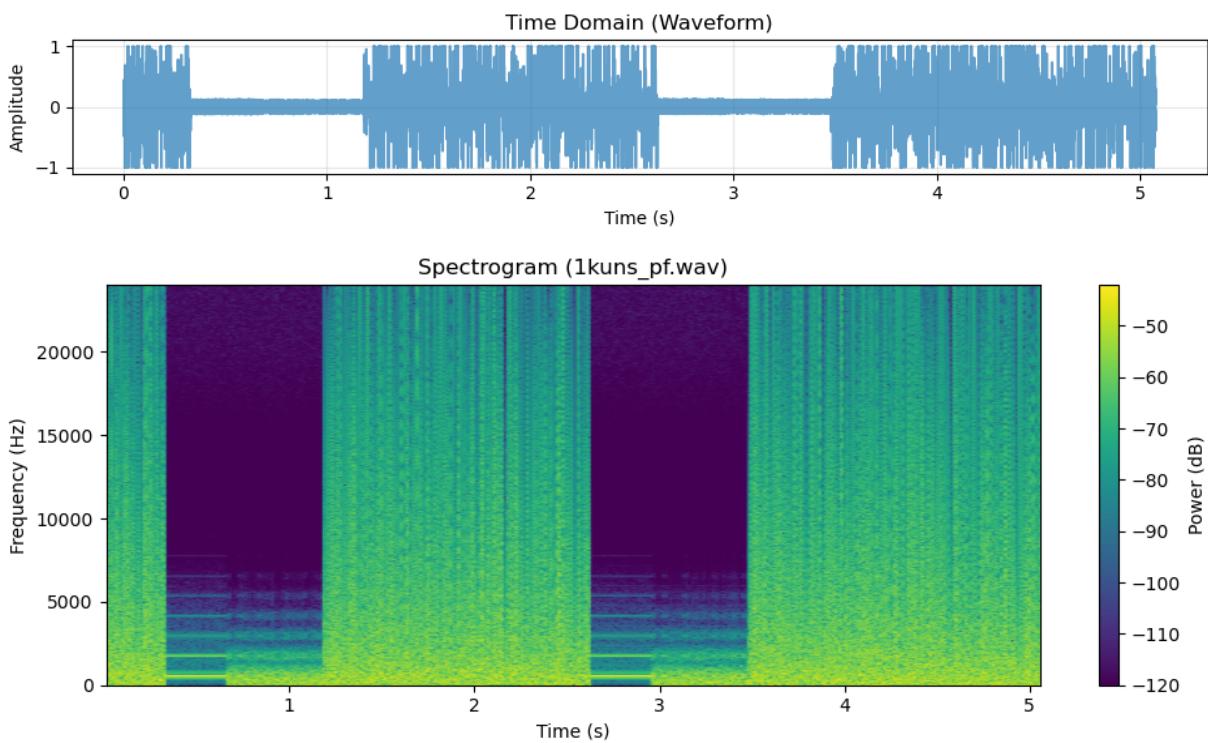
# 1. Time Domain
fig_time, ax_time = plt.subplots(figsize=(10, 2))
t = np.arange(len(data)) / fs
ax_time.plot(t, data, alpha=0.7)
ax_time.set_title("Time Domain (Waveform)")
ax_time.set_xlabel("Time (s)")
ax_time.set_ylabel("Amplitude")
ax_time.grid(True, alpha=0.3)
plt.tight_layout()

# 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** carri
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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
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In [5]: result = pipeline.decode(filename, sat_id)
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Running decoder: pixi run gr_satellites 1KUNS-PF --wavfile satellite-recordings/1kuns_pf.wav
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In [6]: result
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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          reserved
= 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
3.0\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
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
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': ''}
```

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