Title

Names

This is a scratch notebook developed during class to talk through one way to approach the resonance data.

In[•]:=
```
Clear["Global`*"]; DateString[]
SetDirectory[NotebookDirectory[]];
```

Out[•]=
```
Fri 14 Mar 2025 13:23:49
```

In[•]:=
```
files = FileNames["TO-driven*.csv"]
```

Out[•]=
```
{TO-driven-0.20Hz.csv, TO-driven-0.40Hz.csv,
 TO-driven-0.78Hz.csv, TO-driven-0.82Hz.csv, TO-driven-1.00Hz.csv}
```

In[•]:=
```
files[[2]]
```

Out[•]=
```
TO-driven-0.40Hz.csv
```

In[•]:=
```
osc[V_, f_, ϕ_, Voff_, t_] := V Sin[2 π f t - ϕ] + Voff
```

In[•]:=
```
osc[V, f, ϕ, Voff, t]
```

Out[•]=
```
Voff + V Sin[2 f π t - ϕ]
```

In[•]:=
```
files
```

Out[•]=
```
{TO-driven-0.20Hz.csv, TO-driven-0.40Hz.csv,
 TO-driven-0.78Hz.csv, TO-driven-0.82Hz.csv, TO-driven-1.00Hz.csv}
```

In[•]:=
```
fset = {0.20, 0.40, 0.78, 0.82, 1.00}
```

Out[•]=
```
{0.2, 0.4, 0.78, 0.82, 1.}
```

In[•]:=
```
FilePrint[files[[2]], 3]
```

```
"Latest: Time (s)","Latest: Potential (V)","Latest: Potential 2 (V)"

0,0.00457763671875,0.0161743164063

0.002,-0.00030517578125,0.0112915039063
```

```
In[•]:= Select[Import[files[[2]], "CSV"], Length[#] == 3 && VectorQ[#, NumberQ] &]
```

Out[•]=

```
{{0., 0.00457764, 0.0161743}, {0.002, -0.000305176, 0.0112915}, {0.004, -0.000305176, 0.0161743},
 {0.006, -0.000305176, 0.0210571}, {0.008, -0.000305176, 0.0161743}, {0.01, 0.00457764, 0.0259399},
 <<14989>>, {29.99, -0.0100708, 0.00152588}, {29.992, -0.0100708, 0.00152588},
 {29.994, -0.00518799, 0.00152588}, {29.996, -0.00518799, 0.00640869},
 {29.998, -0.00518799, 0.00640869}, {30., -0.00518799, 0.00640869}}
```

Full expression not available (original memory size: 1.8 MB)

```
In[•]:= getVin[filename_] := Select[Import[filename, "CSV"],
          Length[#] == 3 && VectorQ[#, NumberQ] &][[All, {1, 2}]]
```

```
In[•]:= getVin[files[[2]]]
```

Out[•]=

```
{{0., 0.00457764}, {0.002, -0.000305176}, {0.004, -0.000305176}, {0.006, -0.000305176},
 {0.008, -0.000305176}, {0.01, 0.00457764}, {0.012, 0.00457764}, {0.014, 0.00457764},
 {0.016, 0.00457764}, {0.018, 0.00457764}, <<14981>>, {29.982, -0.0149536}, {29.984, -0.0100708},
 {29.986, -0.0100708}, {29.988, -0.0100708}, {29.99, -0.0100708}, {29.992, -0.0100708},
 {29.994, -0.00518799}, {29.996, -0.00518799}, {29.998, -0.00518799}, {30., -0.00518799}}
```

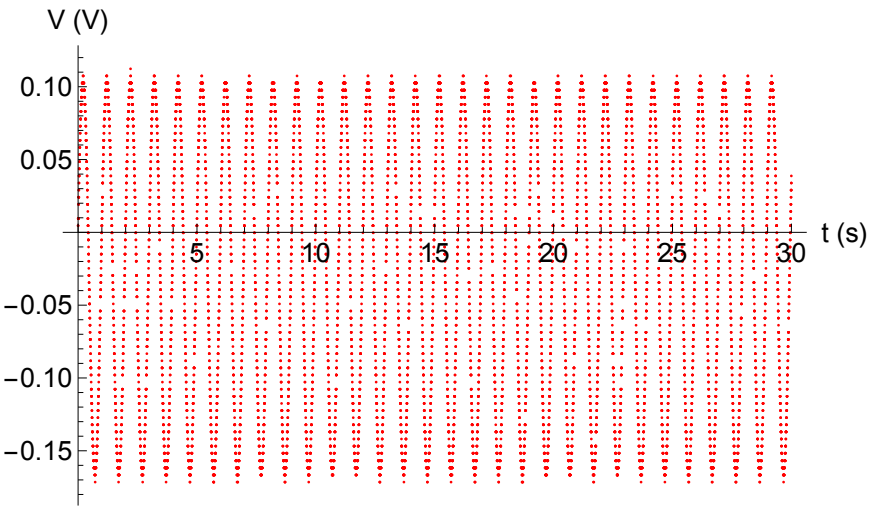
Full expression not available (original memory size: 1.4 MB)

```
In[•]:= getVout[filename_] := Select[Import[filename, "CSV"],
          Length[#] == 3 && VectorQ[#, NumberQ] &][[All, {1, 3}]]
```

```
In[•]:= showData[data_] := ListPlot[data, PlotStyle → Red, LabelStyle → Larger,
          AxesLabel → {"t (s)", "V (V)"}, ImageSize → Scaled[0.5]]
```

```
In[•]:= showData[getVin[files[[5]]]]
```

Out[•]=



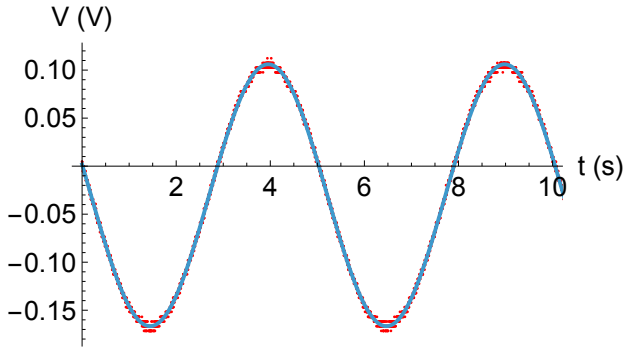
In[•]:=
```
Clear[fitV]
fitV[data_, ffg_, ϕguess_] := NonlinearModelFit[data,
  {osc[V, f, ϕ, Voff, t], V > 0, ffg - 0.01 ≤ f ≤ ffg + 0.01},
  {V, {f, ffg}, {ϕ, ϕguess}, Voff},
  t]
```

In[•]:=
```
i = 1;
vdata = getVin[files[[i]]];
fset[[i]]
fit = fitV[vdata, fset[[i]], ϕinguess[[i]]];
fit["BestFitParameters"]
Show[{
  showData[vdata],
  Plot[fit[t], {t, 0, 30}]}, PlotRange → {{0, 10}, All}]
```

Out[•]=
```
0.2
```

Out[•]=
$$\{V \to 0.136298,\ f \to 0.199123,\ \phi \to 3.37857,\ Voff \to -0.0302852\}$$

Out[•]=



In[•]:=
```
ϕinguess = {π, 0, 0, 0, 0};
ϕoutguess = {π, 0, π / 2, π / 2, π }
```

Out[•]=
$$\left\{\pi, 0, \frac{\pi}{2}, \frac{\pi}{2}, \pi\right\}$$

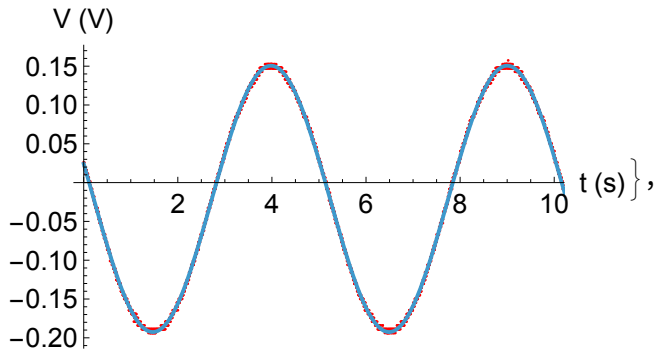
In[•]:=
```
fset
```

Out[•]=
```
{0.2, 0.4, 0.78, 0.82, 1.}
```

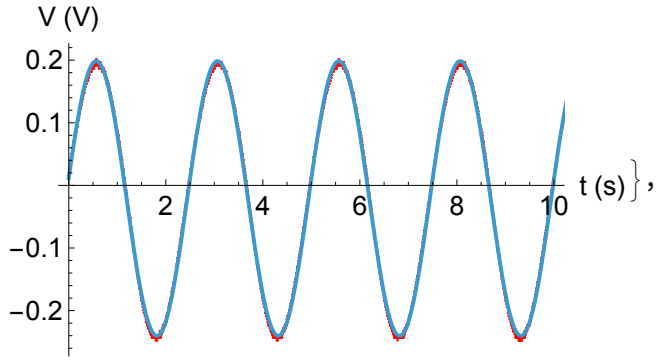
In[•]:=
```
Table[
 {vdata = getVout[files[[i]]];
fset[[i]],
  fit = fitV[vdata, fset[[i]], ϕoutguess[[i]]];
fit["BestFitParameters"],
  Show[{
    showData[vdata],
    Plot[fit[t], {t, 0, 30}]}, PlotRange → {{0, 10}, All}]},
 {i, 1, Length[files]}]
```

Out[•]=

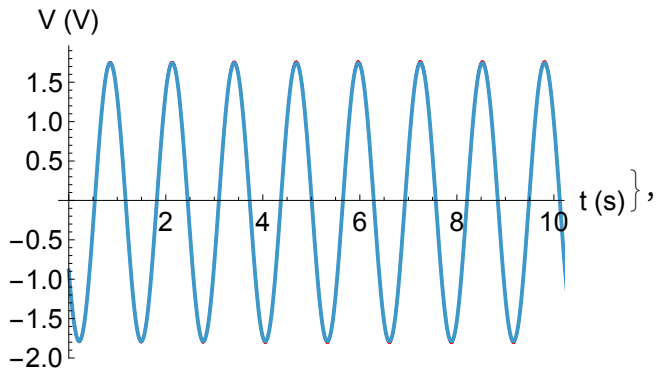
$$\{\{0.2, \{V \to 0.171556, f \to 0.199122, \phi \to 3.40808, Voff \to -0.020975\},$$



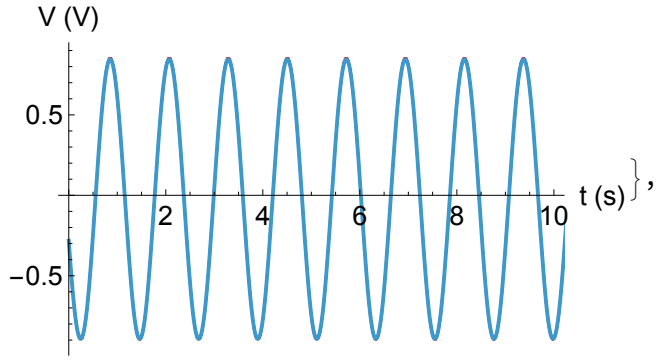
$$\{0.4, \{V \to 0.21928, f \to 0.399798, \phi \to -0.148517, Voff \to -0.020884\},$$



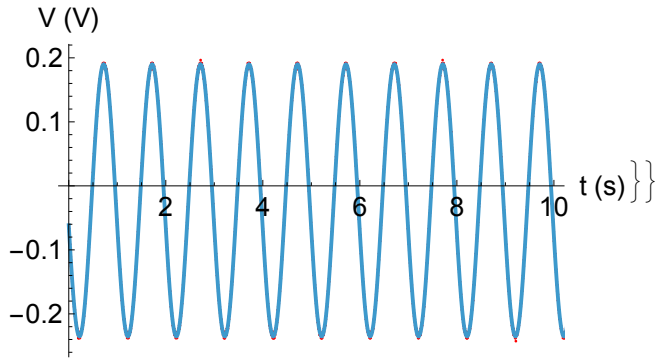
$$\{0.78, \{V \to 1.76557, f \to 0.782053, \phi \to 2.62762, Voff \to -0.0223342\},$$



$$\{0.82, \{V \to 0.868951, f \to 0.821653, \phi \to 2.83861, Voff \to -0.0234545\},$$



$$\{1., \{V \to 0.212621, f \to 1.00136, \phi \to 2.95752, Voff \to -0.0225893\},$$



In[•]:=

```
infits =
 Table[fitV[getVin[files[[i]]], fset[[i]], ϕinguess[[i]]], {i, 1, Length[files]}]
```

Out[•]=

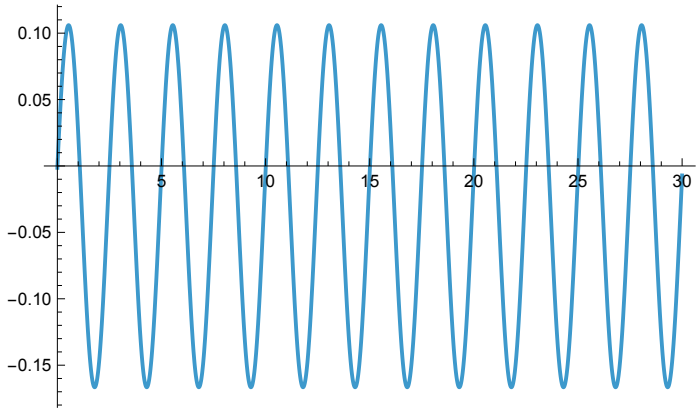
$$\{\text{FittedModel}[-0.0303 - 0.136 \sin[3.38 - 1.25\,t]],$$

$$\text{FittedModel}[-0.0303 + 0.136 \sin[0.214 + 2.51\,t]], \text{FittedModel}[-0.0301 + 0.134 \sin[0.236 + 4.91\,t]],$$

$$\text{FittedModel}[-0.0301 + 0.135 \sin[0.227 + 5.16\,t]], \text{FittedModel}[-0.0304 + 0.135 \sin[0.246 + 6.29\,t]]\}$$

In[ ]:=
```
Plot[infits[[2]][t], {t, 0, 30}]
```

Out[ ]=



In[ ]:=
```
infitparameters = Table[infits[[i]]["BestFitParameters"], {i, 1, Length[files]}]
```

Out[ ]=
```
{{V → 0.136298, f → 0.199123, ϕ → 3.37857, Voff → -0.0302852},
 {V → 0.136274, f → 0.399772, ϕ → -0.213803, Voff → -0.0303078},
 {V → 0.133821, f → 0.782074, ϕ → -0.235697, Voff → -0.0301311},
 {V → 0.134595, f → 0.821653, ϕ → -0.226963, Voff → -0.030096},
 {V → 0.135033, f → 1.00137, ϕ → -0.245772, Voff → -0.0303674}}
```

In[ ]:=
```
Vins = V /. infitparameters
```

Out[ ]=
```
{0.136298, 0.136274, 0.133821, 0.134595, 0.135033}
```

In[ ]:=
```
ϕins = ϕ /. infitparameters
```

Out[ ]=
```
{3.37857, -0.213803, -0.235697, -0.226963, -0.245772}
```