In[140]:=
```
Manipulate[
  meanRCS = Import["rcs-values.dat"];
  (* pointer to data file *)
  index = ν - 2;
  (* wavelegnth in meters *)
  λ = Round[ℂ/(ν 1 000 000)];
  (* grab rcs at specific wavelength *)
  rcs = meanRCS[[index]];
  (* number of data points *)
  Θ = Table[
     k π/180
     , {k, -180, 180}];
  m = Length[Θ];
  (* center on nose (yaw angle α = 90 ) *)
  σ = RotateLeft[rcs, 180];
  (* characterize variation for plot range *)
  mx = Max[σ];
  mn = Min[σ];
  Λ = 1.1;
  {top, bot} = {1.1 mx, 0.9 mn};
  (* plot subtitles *)
  subtitle = "ν = " <> ToString[ν] <> " MHz";
  subtitle = subtitle <> ", λ = " <> ToString[λ] <> " m";
  (* scatter plot of data points *)
  z = {Θ, σ}ᵀ;
  g000 = ListPlot[z, PlotStyle → {Purple, Opacity[0.5], PointSize[0.005]}];
  (* assemble linear system *)
  avector = Table[Cos[j θ], {j, 0, d}];
  A = Table[
     Simplify[avector /. θ → Θ[[k]]]
     , {k, m}];
  (* compute Fourier-Bessel coefficients *)
  c = LeastSquares[A, σ];
  (* approximation function *)
  Clear[f];
  f[θ_] = c.avector;
  (* approximation vector *)
  F = f[θ] /. θ → Θ;
  (* residual error *)
  r = σ - F;
  R = {Θ, r}ᵀ;
```

```
(* total error *)
r2 = r.r;
(* uncertainty propagation *)
ϵ = Sqrt[r2/(m - (d + 1)) Diagonal[Inverse[Aᴴ.A // N]]];
(* signal to noise *)
γ = Last[c]/Last[ϵ];
(* function *)
g001 = Plot[f[θ], {θ, -π, π},
  Frame → True,
  FrameTicks → fticks,
  PlotStyle → {Opacity[0.25], Blue}];
(* bar chart *)
gbars = BarChart[c,
  Frame → True,
  PlotLabel → "Amplitudes for d = " <> ToString[d] <> lf <> subtitle,
  ChartStyle → {{Blue}, {Opacity[0.1]}},
  FrameTicks → {{Automatic, Automatic}, {Table[
      {k + 1, Subscript["a", k]}
      , {k, 0, d}], Automatic}},
  ipad, isize];
(* compare data to fit *)
dsubtitle = subtitle <> ", d = " <> ToString[d];
ga = Show[{g001, g000},
  PlotLabel → sty["MoM RCS vs Fourier Cosine Expansion" <> lf <> dsubtitle],
  FrameLabel → {sty["Yaw angle, α"], sty["Mean total RCS, <σT>"]},
  FrameTicks → fticks,
  PlotRange → {bot, top},
  isize, ipad];
(* residual error *)
gb = ListPlot[R,
  Frame → True,
  FrameTicks → fticks,
  FrameLabel → {sty["Yaw angle, α"], sty["Residual error"]},
  (* PlotRange→Λ{-1,1}, *)
  PlotStyle → {Red, PointSize[0.005]},
  PlotLabel → sty["Fourier Approximation Error" <> lf <> dsubtitle],
  isize, ipad];
(* bar chart *)
gbars = BarChart[c,
  Frame → True,
```

```
  PlotLabel → "Amplitudes for d = " <> ToString[d] <> lf <> subtitle,
  ChartStyle → {{Blue}, {Opacity[0.1]}},
  FrameTicks → {{Automatic, Automatic}, {Table[
      {k + 1, Subscript["a", k]}
      , {k, 0, d}], Automatic}},
  ipad, isize];
(* amplitudes with errors *)
ebars = Table[
  {k - 1, Around[c[[k]], ϵ[[k]]]}
  , {k, Length[c]}];
gebars = ListPlot[ebars,
  isize,
  Frame → True,
  FrameTicks → {{Automatic, Automatic},
    {Table[{k, Subscript["a", k]}, {k, 0, Length[ebars]}], Automatic}},
  PlotLabel → "Amplitudes with errors for d = " <> ToString[d] <> lf <> subtitle,
  PlotStyle → Blue,
  PlotRange → {{-0.5, d + 0.5}, Full},
  isize, ipad];
(* group plots *)
gout = GraphicsGrid[{{ga, gb}, {gbars, gebars}},
  ImageSize → 12 × 72]
, {ν, 3, 30, 1}, {d, 0, 25, 1}]
```

ν

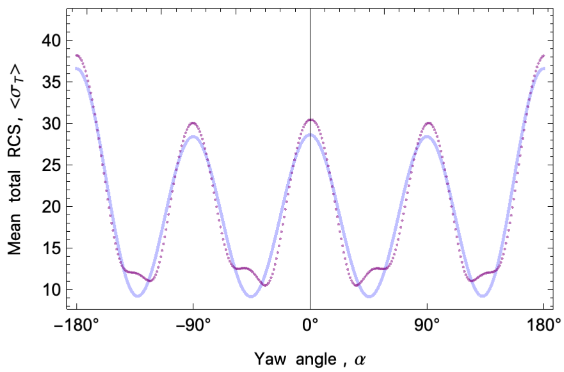
4

d

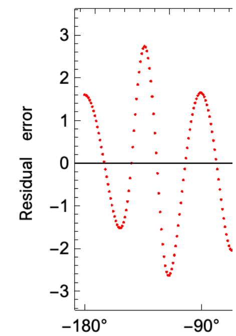
5

Out[140]=

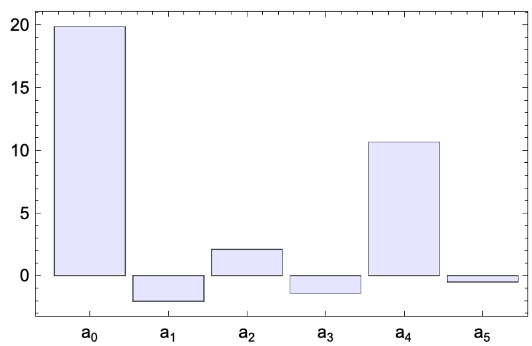
MoM RCS vs Fourier Cosine Expansion
ν = 4 MHz, λ = 75 m, d = 5



Fourie
ν = 4



Amplitudes for *d* = 5
ν = 4 MHz, λ = 75 m



Amplit