ToyScan1

This *Mathematica* notebook plots the Markov chains obtained by running ToyScan1. As defined in main.cpp, this scan uses 10 chains and 10k steps to seek out the point (1, 1, 1) with a Gaussian likelihood profile, with uncertainties (0.1, 0.5, 1.0).

Import and parse the chains

In[1]:=
```
SetDirectory[NotebookDirectory[]];

Chains = {};
Module[{i, FileData},
 For[i = 1, i ≤ 10, i++,
  FileData = Import["chains/ToyScan1_chain" <> ToString[i] <> ".dat"];
  AppendTo[Chains, Split[FileData, # ≠ {} &]]
 ]
]
```

In[4]:=
```
Chains[[1, 1 ;; 10]] // MatrixForm
```

Out[4]//MatrixForm=

{0.382377, 7.95707, -9.91522}	{12.9586, 2.57236, -1.48225}	$\{6.38286\times10^{-77}\}$	{}
{0.382377, 7.95707, -9.91522}	{12.9586, 2.57236, -1.48225}	$\{6.38286\times10^{-77}\}$	{}
{0.632815, 8.86367, -1.28692}	{8.19769, 1.85352, -1.52414}	$\{1.68026\times10^{-58}\}$	{}
{0.632815, 8.86367, -1.28692}	{8.19769, 1.85352, -1.52414}	$\{1.68026\times10^{-58}\}$	{}
{0.632815, 8.86367, -1.28692}	{8.19769, 1.85352, -1.52414}	$\{1.68026\times10^{-58}\}$	{}
{0.632815, 8.86367, -1.28692}	{8.19769, 1.85352, -1.52414}	$\{1.68026\times10^{-58}\}$	{}
{0.632815, 8.86367, -1.28692}	{8.19769, 1.85352, -1.52414}	$\{1.68026\times10^{-58}\}$	{}
{1.41015, 9.20467, 1.92356}	{8.26667, 1.45884, 1.52085}	$\{4.91249\times10^{-63}\}$	{}
{1.41015, 9.20467, 1.92356}	{8.26667, 1.45884, 1.52085}	$\{4.91249\times10^{-63}\}$	{}
{1.41015, 9.20467, 1.92356}	{8.26667, 1.45884, 1.52085}	$\{4.91249\times10^{-63}\}$	{}

Setting up accessor functions

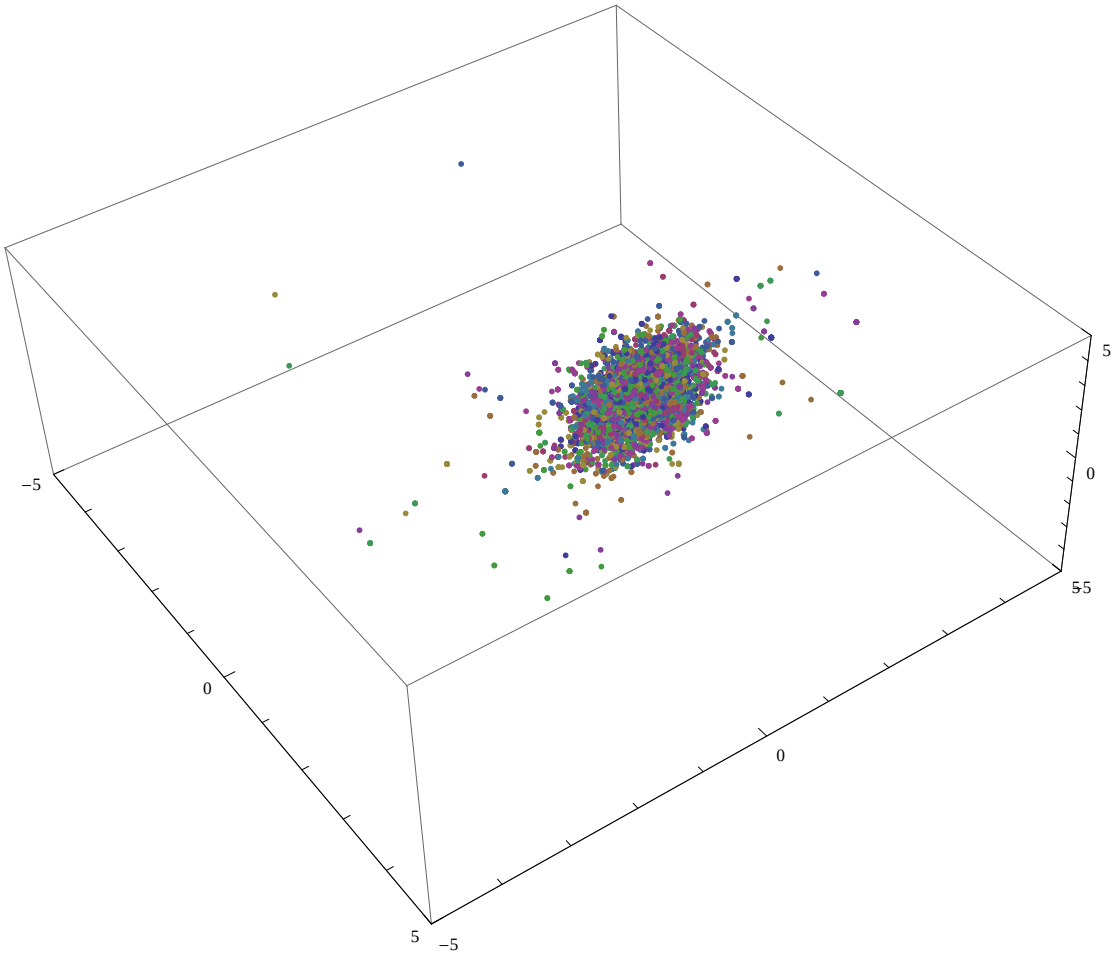
In[35]:=
```
ChainLength[iChain_] := Length[Chains[[iChain]]];

Parameters[iChain_, iPoint_] := Chains[[iChain, iPoint, 1]];
r[iChain_, iPoint_] := Chains[[iChain, iPoint, 2, 1]];
θ[iChain_, iPoint_] := Chains[[iChain, iPoint, 2, 2]];
ϕ[iChain_, iPoint_] := Chains[[iChain, iPoint, 2, 3]];
NegativeLogLikelihood[iChain_, iPoint_] :=
  -Log[10, Chains[[iChain, iPoint, 3, 1]]];
```

Plotting the chains

Here I plot the full chains, from beginning to end, without burning the initial fraction. The different colors correspond to different chains.

In[18]:=
```
ListPointPlot3D[Parameters[All, All],
 PlotRange → {{-5, 5}, {-5, 5}, {-5, 5}}, ImageSize → Large]
```

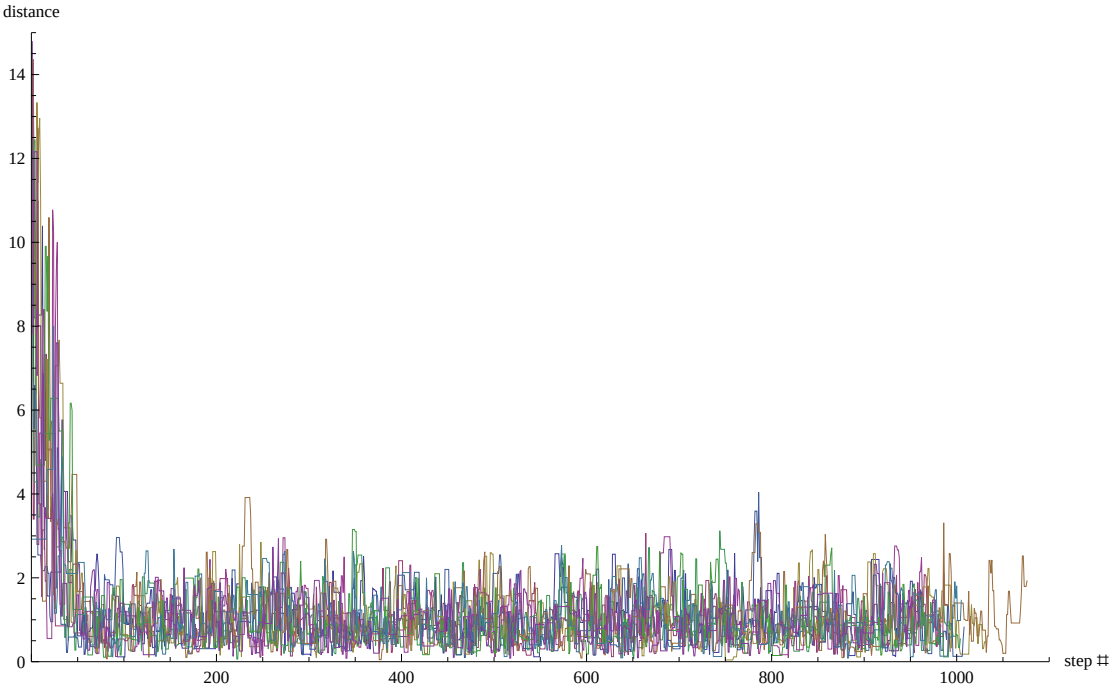
Out[18]=



Plotting distance from the target point

In[31]:=
```
ListPlot[r[All, All], Joined → True, PlotRange → {{0, 1100}, {0, 15}},
 AxesLabel → {"step #", "distance"}, ImageSize → Large]
```

Out[31]=



Plotting likelihood

This plots the negative log-likelihood of the points in the chains. It shows how many orders of magnitude below likelihood == 1.0 (which indicates perfect agreement with the target point) the likelihood is at. As the chains' likelihood increases, the negative log-likelihood approaches zero.

In[46]:=
```
ListPlot[NegativeLogLikelihood[All, All],
 Joined → True, PlotRange → {{0, 1100}, {0, 100}},
 AxesLabel → {"step #", "-log10L"}, ImageSize → Large]
```

Out[46]=