

Sample notebook for processing spectrum image

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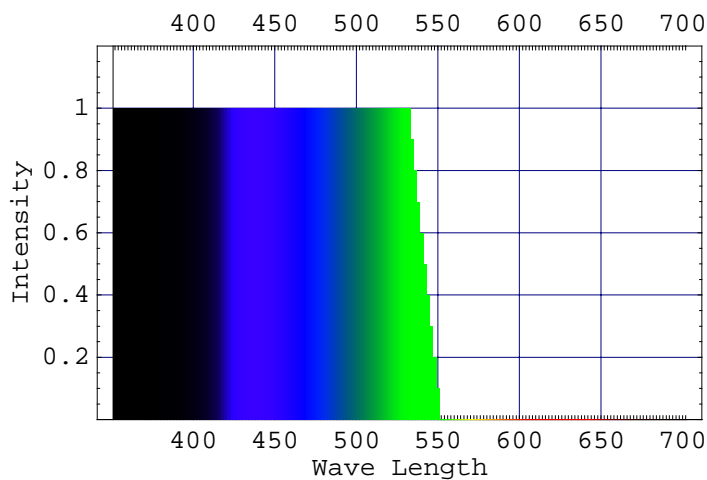
計算部分

(* 照明光を決める *)

```
In[236]:= SetLight[ D65 ];
```

(* シアン色をプロットしてみる *)

```
In[365]:= plotSpector[ cyan ];
```

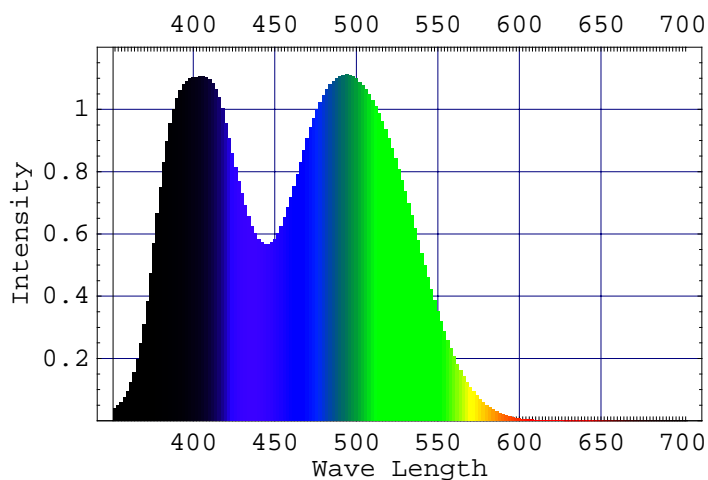


(* RGBでシアンの近似色を作成する *)

```
In[337]:= rgb = fitSpector[ cyan, red, green, blue]
```

```
Out[337]= {0., 1.0127, 0.878107}
```

```
In[357]:= plotSpectrum[ { red[#], green[#], blue[#] }.rgb & ];
```



(* Lab空間で比較してみる *)

```
In[340]:= setcolor[ cyan ]; {L, a, b}
```

```
Out[340]= {90.1998, -47.7048, -12.0151}
```

```
In[342]:= setcolor[ { red[#], green[#], blue[#] }.rgb & ]; {L, a, b}
```

```
Out[342]= {89.3292, -39.6907, -6.0555}
```

■ 画像ファイルを読み込む

(* もちろんファイルは別途用意しておく *)

```
In[345]:= image = Import["C:\Mathematica\mm.png", "PNG"];
```

```
In[353]:= Show[image];
```



(* ピクセル値のみ取得 *)

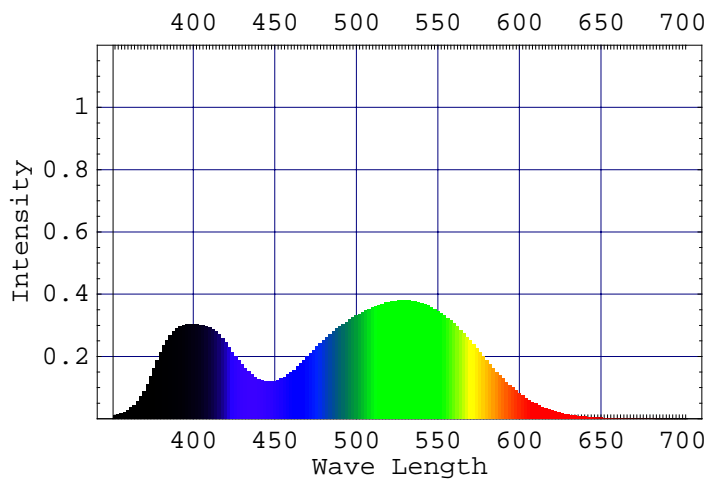
```
In[347]:= pixels = image[[1, 1]];
```

(* 適当な場所のピクセルのスペクトルを表示する *)

```
In[366]:= pixels[[2]][[2]] / 255
```

```
Out[366]= { 107 / 255 , 76 / 255 , 21 / 85 }
```

```
In[367]:= plotSpectrum[ { red[#], green[#], blue[#] }.% & ] ;
```



各種デ-タ定義

```
In[27]:= Off[General::spell]
```

```
In[343]:= << Graphics`Graphics`
```

```
In[344]:= << Graphics`Graphics3D`
```

```
In[28]:= (* [連続する] スペクトルを離散化する際の条件設定 *)
```

```
In[81]:= MinWL = 350;  
MaxWL = 800;  
divWL = 2;
```

色変換関数

■ D65光源

```
In[84]:= D65 = Interpolation[{{350, 0.4491`}, {351, 0.4517456`},
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```

■ CIE1986等色関数


```
In[85]:= xCIE1986 =  
Interpolation[{{350, 0}, {355, 0}, {360, 0}, {365, 0}, {370, 0},  
{375, 0}, {380, 0.0014}, {385, 0.0022}, {390, 0.0042},  
{395, 0.0076}, {400, 0.0143}, {405, 0.0232}, {410, 0.0435},  
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{475, 0.1421}, {480, 0.0956}, {485, 0.058}, {490, 0.032},  
{495, 0.0147}, {500, 0.0049}, {505, 0.0024}, {510, 0.0093},  
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{655, 0.2187}, {660, 0.1649}, {665, 0.1212}, {670, 0.0874},  
{675, 0.0636}, {680, 0.0468}, {685, 0.0329}, {690, 0.0227},  
{695, 0.0158}, {700, 0.0114}, {705, 0.0081}, {710, 0.0058},  
{715, 0.0041}, {720, 0.0029}, {725, 0.002}, {730, 0.0014},  
{735, 0.001}, {740, 0.0007}, {745, 0.0005}, {750, 0.0003},  
{755, 0.0002}, {760, 0.0002}, {765, 0.0001}, {770, 0.0001},  
{775, 0.0001}, {780, 0}, {785, 0}, {790, 0}, {795, 0}, {800, 0}}];
```

```

In[86]:= yCIE1986 =
  Interpolation[{{350, 0}, {355, 0}, {360, 0}, {365, 0}, {370, 0},
    {375, 0}, {380, 0}, {385, 0.0001}, {390, 0.0001}, {395, 0.0002},
    {400, 0.0004}, {405, 0.0006}, {410, 0.0012}, {415, 0.0022},
    {420, 0.004}, {425, 0.0073}, {430, 0.0116}, {435, 0.0168},
    {440, 0.023}, {445, 0.0298}, {450, 0.038}, {455, 0.048},
    {460, 0.06}, {465, 0.0739}, {470, 0.091}, {475, 0.1126},
    {480, 0.139}, {485, 0.1693}, {490, 0.208}, {495, 0.2586},
    {500, 0.323}, {505, 0.4073}, {510, 0.503}, {515, 0.6082},
    {520, 0.71}, {525, 0.7932}, {530, 0.862}, {535, 0.9149},
    {540, 0.954}, {545, 0.9803}, {550, 0.995}, {555, 1}, {560, 0.995},
    {565, 0.9786}, {570, 0.952}, {575, 0.9154}, {580, 0.87},
    {585, 0.8163}, {590, 0.757}, {595, 0.6949}, {600, 0.631},
    {605, 0.5668}, {610, 0.503}, {615, 0.4412}, {620, 0.381},
    {625, 0.321}, {630, 0.265}, {635, 0.217}, {640, 0.175},
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    {745, 0.0002}, {750, 0.0001}, {755, 0.0001}, {760, 0.0001},
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    {795, 0}, {800, 0}}];

```

```

In[87]:= zCIE1986 =
  Interpolation[{{350, 0}, {355, 0}, {360, 0}, {365, 0}, {370, 0},
    {375, 0}, {380, 0.0065}, {385, 0.0105}, {390, 0.0201},
    {395, 0.0362}, {400, 0.0679}, {405, 0.1102}, {410, 0.2074},
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    {555, 0.0057}, {560, 0.0039}, {565, 0.0027}, {570, 0.0021},
    {575, 0.0018}, {580, 0.0017}, {585, 0.0014}, {590, 0.0011},
    {595, 0.001}, {600, 0.0008}, {605, 0.0006}, {610, 0.0003},
    {615, 0.0002}, {620, 0.0002}, {625, 0.0001}, {630, 0}, {635, 0},
    {640, 0}, {645, 0}, {650, 0}, {655, 0}, {660, 0}, {665, 0},
    {670, 0}, {675, 0}, {680, 0}, {685, 0}, {690, 0}, {695, 0},
    {700, 0}, {705, 0}, {710, 0}, {715, 0}, {720, 0}, {725, 0},
    {730, 0}, {735, 0}, {740, 0}, {745, 0}, {750, 0}, {755, 0},
    {760, 0}, {765, 0}, {770, 0}, {775, 0}, {780, 0}, {785, 0},
    {790, 0}, {795, 0}, {800, 0}}];

```

```
In[88]:= (* Yn :=  $\int_{350}^{800} (y_{CIE1986}[x] \text{ RefLight}[x]) dx$ ; *)
```

```
In[89]:= Y1986[ spector_ ] :=
  Sum[ spector[x] yCIE1986[x] , {x, MinWL, MaxWL, divWL}] /
  ( MaxWL - MinWL );
```

```
In[90]:= X1986[ spector_ ] :=
  Sum[ spector[x] xCIE1986[x] , {x, MinWL, MaxWL, divWL}] /
  ( MaxWL - MinWL );
```

```
In[91]:= Z1986[ spector_ ] :=
  Sum[ spector[x] zCIE1986[x] , {x, MinWL, MaxWL, divWL}] /
  ( MaxWL - MinWL );
```

```
In[92]:= Yn0 := Y1986[ RefLight];
```

```
In[93]:= Xn0 := X1986[ RefLight];
```

```
In[94]:= Zn0 := Z1986[ RefLight];
```

```
In[95]:= SetLight[ l_ ] :=
  RefLight[x_] := l[x];
k = 100 / Yn0;
Xn = Xn0 * k;
Zn = Zn0 * k;
Yn = Yn0 * k;
```

```
In[313]:= setcolor[ s_ ] := {X = k X1986[ s ], Y = k Y1986[ s ], Z = k Z1986[ s ]}
```

```
In[100]:= L := 116 (Y / Yn) ^ (1 / 3) - 16;
a := 500 ((X / Xn) ^ (1 / 3) - (Y / Yn) ^ (1 / 3));
b := 200 ((Y / Yn) ^ (1 / 3) - (Z / Zn) ^ (1 / 3));
```

■ 色定義

大雑把に[色]を使う場合のために,[色名→スペクトル]を規定しておく。

```
In[154]:= cyan = Interpolation[ {{350, 1}, {400, 1}, {420, 1}, {440, 1},
  {460, 1}, {480, 1}, {500, 1}, {520, 1}, {540, 1}, {560, 1},
  {580, 1}, {600, 0}, {620, 0}, {640, 0}, {660, 0}, {680, 0},
  {700, 0}, {800, 0}}, InterpolationOrder -> 1];
```

```
In[152]:= magenda =
  Interpolation[ { {350, 1}, {400, 1}, {420, 1}, {440, 1}, {460, 1},
    {480, 1}, {500, 0}, {520, 0}, {540, 0}, {560, 0}, {580, 0},
    {600, 0}, {620, 1}, {640, 1}, {660, 1}, {680, 1}, {700, 1}, {800, 1} },
  InterpolationOrder -> 1];
```

```
In[150]:= yellow = Interpolation[ { {350, 0}, {400, 0}, {420, 0}, {440, 0},
  {460, 0}, {480, 0}, {500, 0}, {520, 0}, {540, 1}, {560, 1},
  {580, 1}, {600, 1}, {620, 1}, {640, 1}, {660, 1}, {680, 1},
  {700, 1}, {800, 1} }, InterpolationOrder -> 1];
```

```
In[106]:= black[x_] = 0 ;
```

```
In[283]:= red[x_] = 1.697085334713303` *
  ( 0.41844 xCIE1986[x] - 0.15866 yCIE1986[x] - 0.08283 zCIE1986[x] );
```

```
In[285]:= green[x_] = 5.087234117636988` *
  ( -0.09117 xCIE1986[x] + 0.25242 yCIE1986[x] + 0.01570 zCIE1986[x] );
```

```
In[286]:= blue[x_] = 3.846060603242237` *
  ( 0.00092 xCIE1986[x] - 0.00255 yCIE1986[x] + 0.17858 zCIE1986[x] );
```

■ 表示関数

```
In[110]:= << Graphics`
```

```
In[124]:= spectorColor[x_] := RGBColor[
  Clip[ 3.240479 xCIE1986 [x] - 1.537150 yCIE1986 [x] -
    0.498535 zCIE1986 [x], {0, 1} ] ,
  Clip[-0.969256 xCIE1986 [x] + 1.875992 yCIE1986 [x] +
    0.041556 zCIE1986 [x], {0, 1} ] ,
  Clip[+0.055648 xCIE1986 [x] - 0.204043 yCIE1986 [x] +
    1.057311 zCIE1986 [x] , {0, 1} ] ];
```

```

In[321]:= plotSpector[s_] := BarChart[
  Table[ s[x], {x, MinWL + 50, MaxWL - 50, divWL}],
  BarLabels → Table[ If[ Mod[x, 50] == 0, x, ""],
    {x, MinWL + divWL, MaxWL - divWL, divWL}],
  BarStyle → Table[ spectorColor[x],
    {x, MinWL + divWL, MaxWL - divWL, divWL}],
  BarSpacing → -0.2,
  BarEdges → False,
  Background → GrayLevel[1],
  Frame → True,
  FrameLabel → {"Wave Length", "Intensity"},
  GridLines → Automatic,
  PlotRange → {0, 1.2}]

(*plotSpector[s_] := Plot[ s[x],{x,MinWL+50,MaxWL-50} ,
  PlotRange→{0,1.2}]*)

```

■ 色近似関数

```

In[322]:= fitSpector[s_, f1_, f2_, f3_] :=
  {c1, c2, c3} /.
  NMinimize[
    {Apply[Plus,
      Table[
        Abs[ s[x]
          - c1 f1[x]
          - c2 f2[x]
          - c3 f3[x] ],
        {x, MinWL + divWL, MaxWL - divWL, divWL} ] ]
    , c1 > 0, c2 > 0, c3 > 0}, {c1, c2, c3}
  ][[2]]

```