

SAS® GLOBAL FORUM 2016

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Visualizing Eye-Tracking Data with SAS®

Creating Heat Maps on Images

#SASGF



Visualizing Eye-Tracking Data with SAS®: Creating Heat Maps on Images

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Educational Testing Service

ABSTRACT

Eye-tracking data are collected by observing a person and logging the coordinates of their gaze on an image. In this example, an image depicting skydivers was presented to a test subject and his gaze was recorded. The intensity of his gaze is represented through varying shades of color. Essentially, the result is a heat map drawn on top of an image.

METHODS

- Data is collected across time. At regularly-spaced intervals, the pixel corresponding to a subject's gaze is recorded.
- A third dimension, z, is projected using `proc freq` :

```
proc freq data=infile noplay;
  tables x*y /
  out=freq (rename=(COUNT=z));
run;
```

- The bivariate distribution is smoothed using `proc kde` :

```
proc kde data=freq;
  bivar x (gridl=0 gridu=599 ngrid=600)
    y (gridl=0 gridu=399 ngrid=400)
  /
  bwm = 1.2 out=density plots=(contour) levels ;
  weight z;
run;
```

- A GTL template is created using `proc template`.

- The template is used to render a heatmap over the image using, `proc sgrender`.

Time	x	y
1	15	10
2	14	8
3	10	4
...

RESULTS



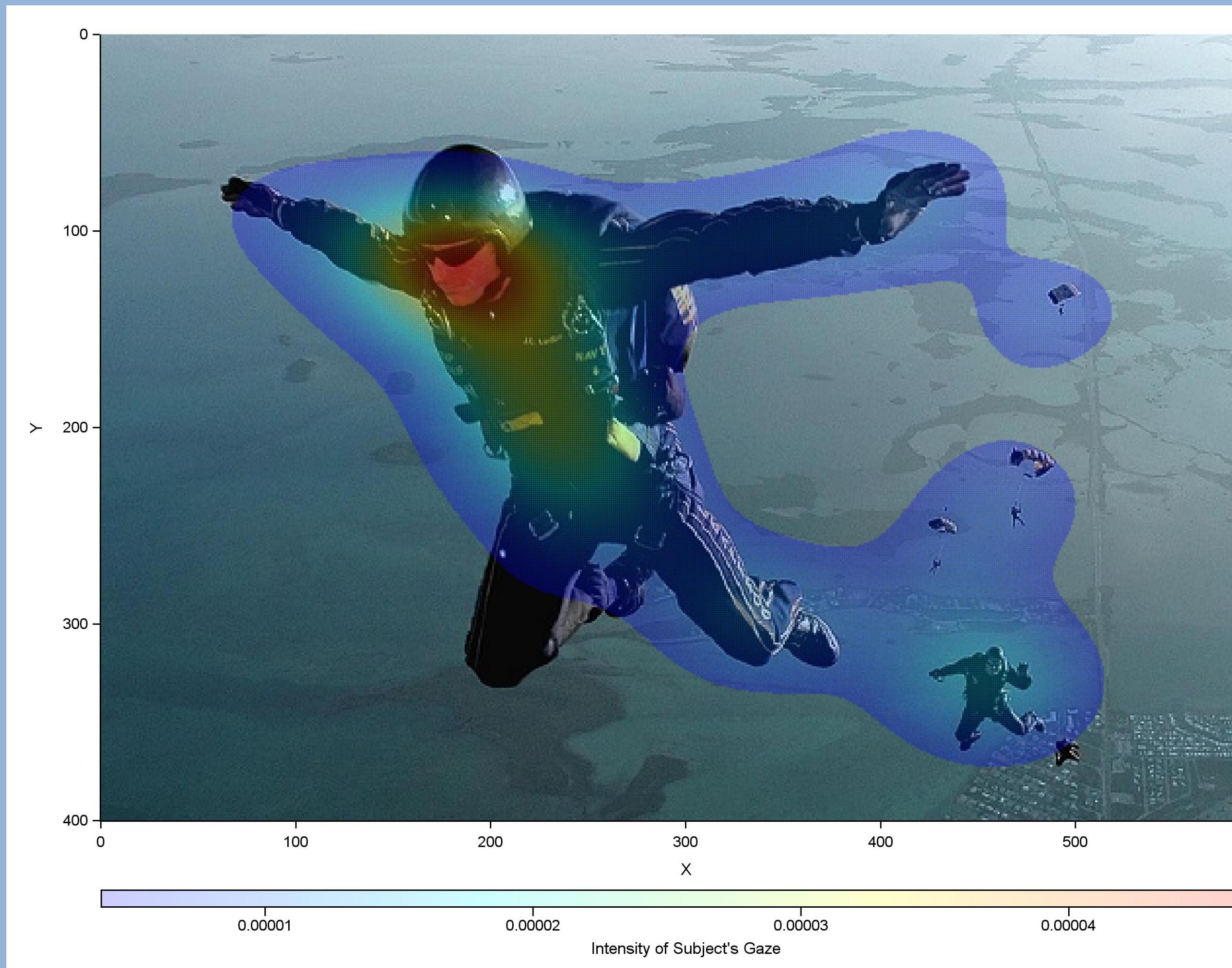
```
%let height = 400; %let width = 600;
```

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Bivariate distribution is smoothed using kernel density estimate procedure



```
proc kde data=freq;
  bivar
    x (gridl=0 gridu=599 ngrid=600)
    y (gridl=0 gridu=399 ngrid=400)
  /
  bwm =1.2  out=density ;
  weight z;
run;
```

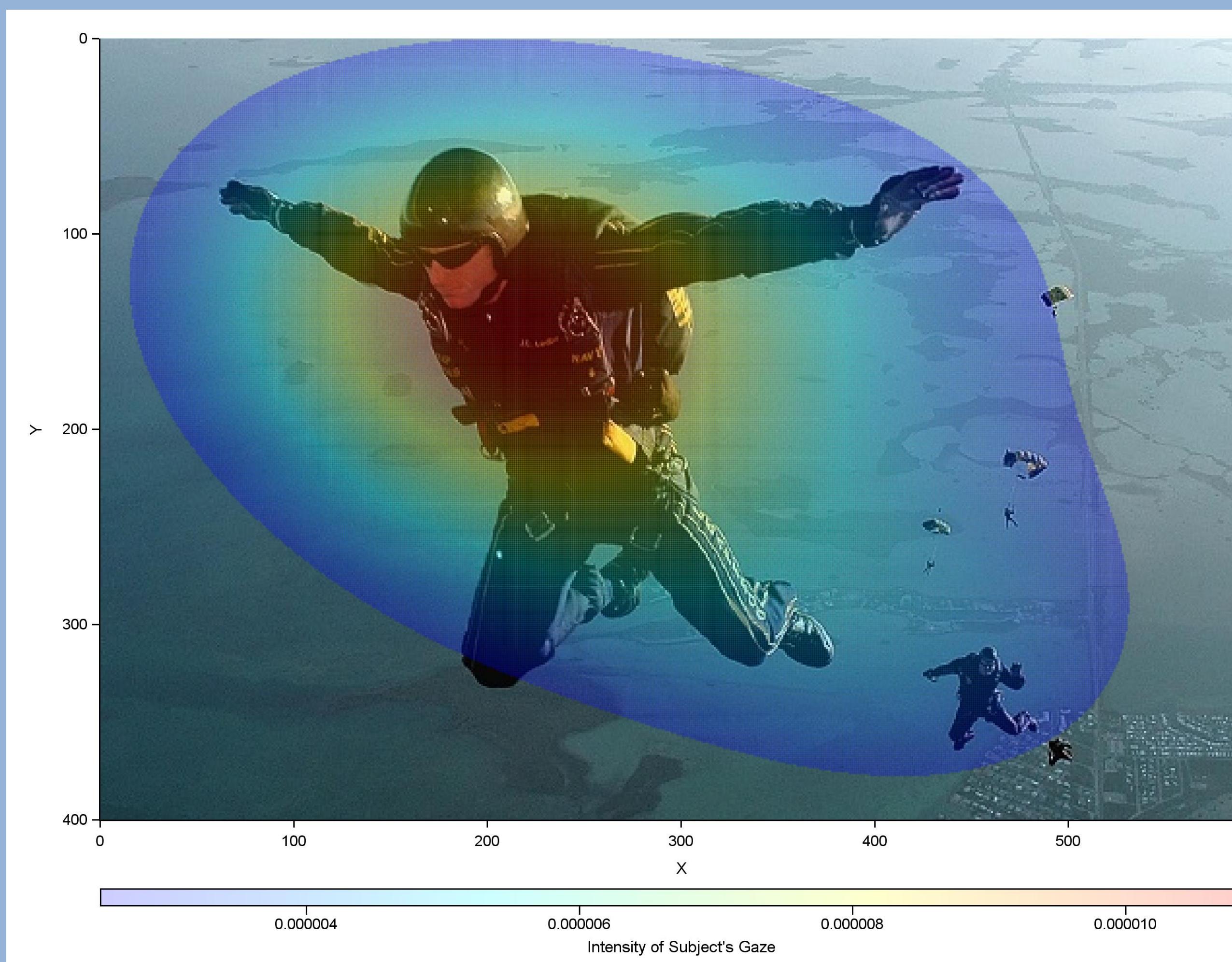


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Adjust the “bandwidth modifier” parameter to desired effect



```
proc kde data=freq;
  bivar
    x (gridl=0 gridu=599 ngrid=600)
    y (gridl=0 gridu=399 ngrid=400)
  /
  bwm =3.0 ← density ;
  weigh2.9;
run;
```

2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8

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```
proc template; define statgraph eyemap; begingraph;

  layout overlay/

    xaxisopts=( offsetmin=0 offsetmax=0 linearopts=(viewmin=0 viewmax=%sysevalf(&width. -1, int)))
    yaxisopts=( offsetmin=0 offsetmax=0 linearopts=(viewmin=0 viewmax=%sysevalf(&height.-1, int))      reverse=true)
    opaque=false walldisplay=none;

    drawimage "C:\Pictures\Jumpers.jpg" /
      width=100 widthunit=percent height=100 heightunit=percent x=50 y=50 drawspace=wallpercent layer=back transparency=0;

    heatmapparm x=x y=y colorresponse=z/
      name = "map" colormodel =(blue cyan yellow red) includemissingcolor=FALSE datatransparency=.8
      xgap=0 ygap=0 xbinaxis=false ybinaxis=false;

    continuouslegend "map" /
      title="Intensity of Subject's Gaze" location=outside valign=bottom ;

  endlayout;

endgraph; end; run;
```

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color mode c b d e c o t h b o e d c h b l b h (f x) M 0 7 E (B k d g K t e k h i l l h i v i o l e t)

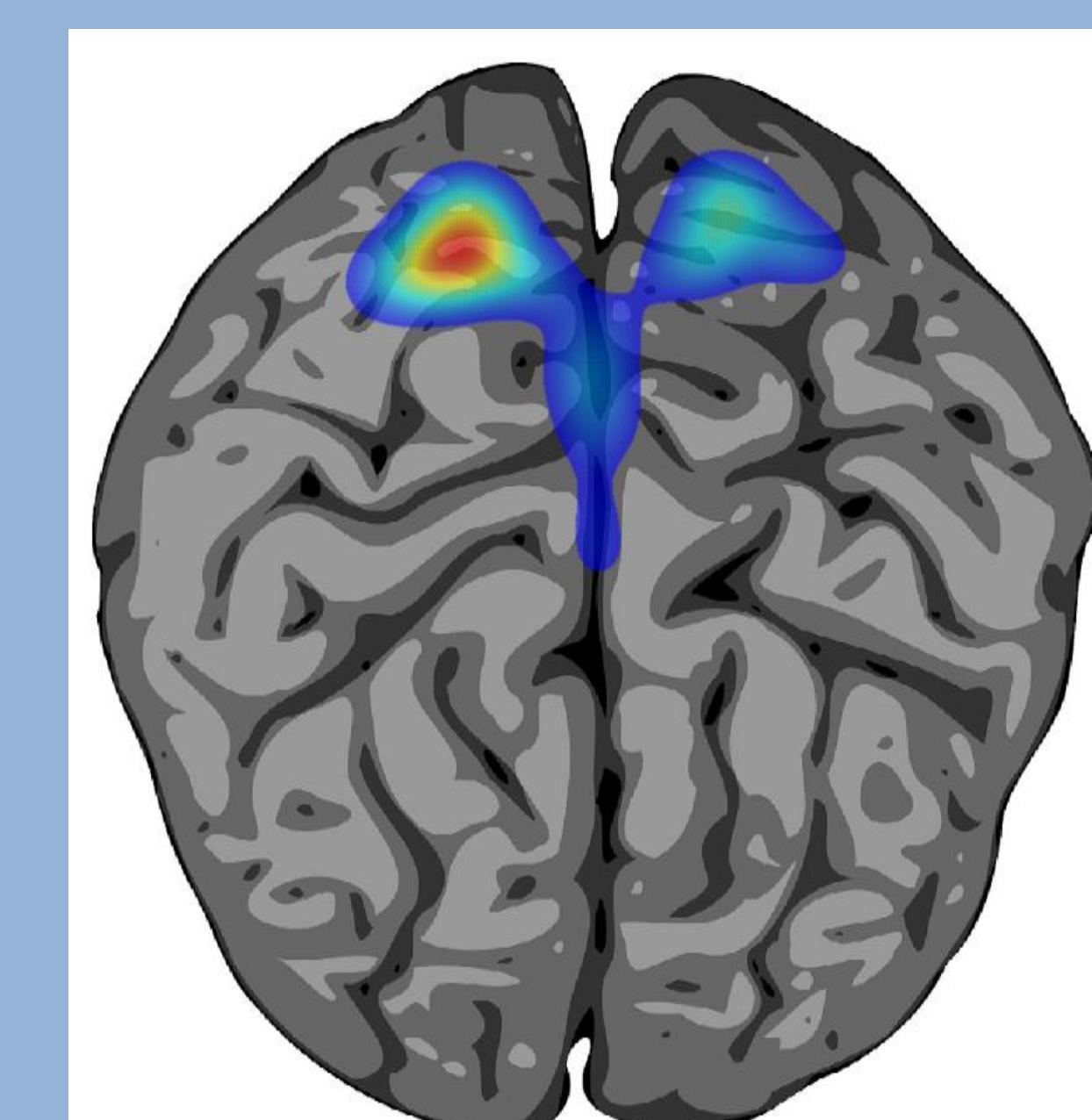
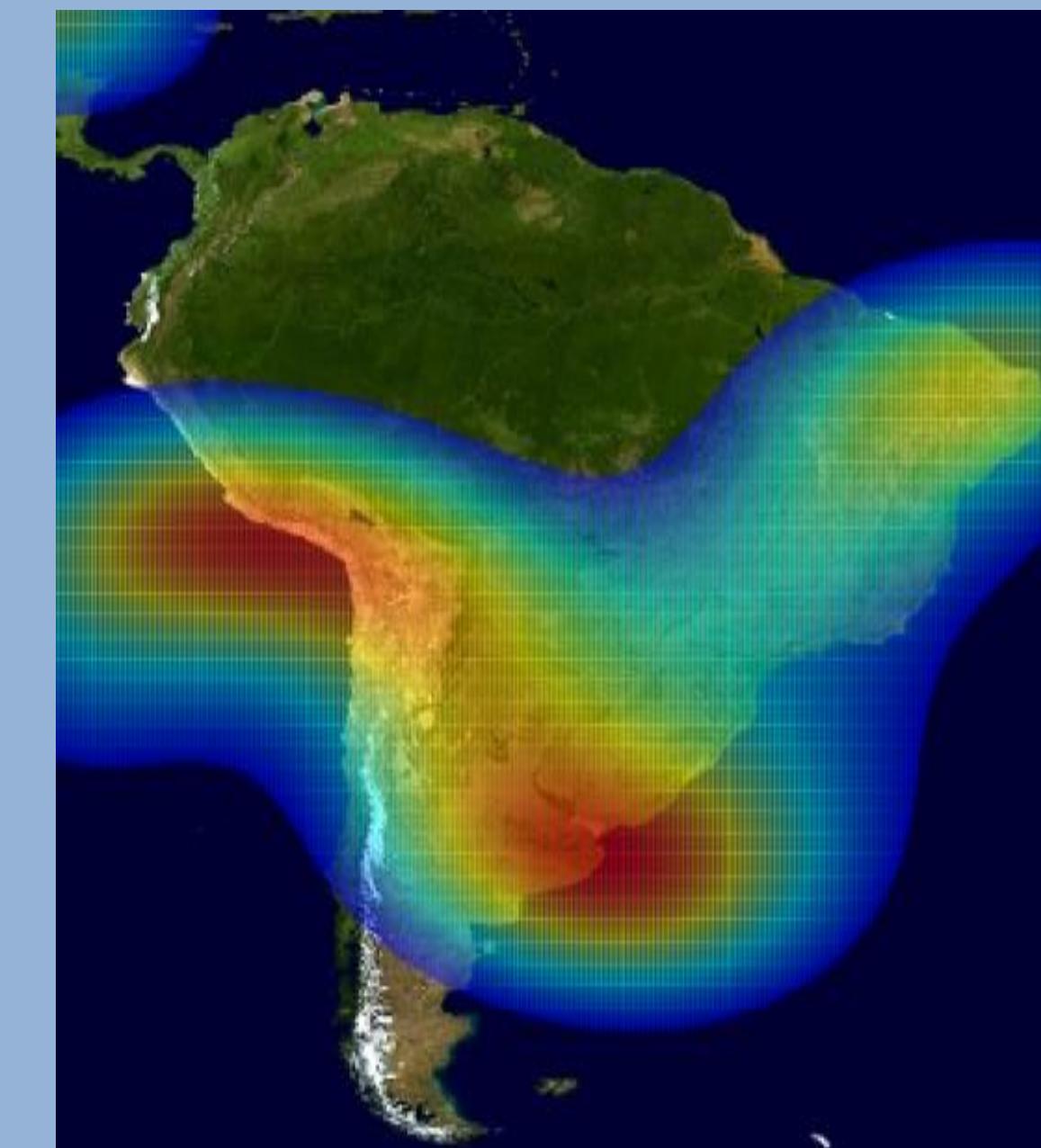
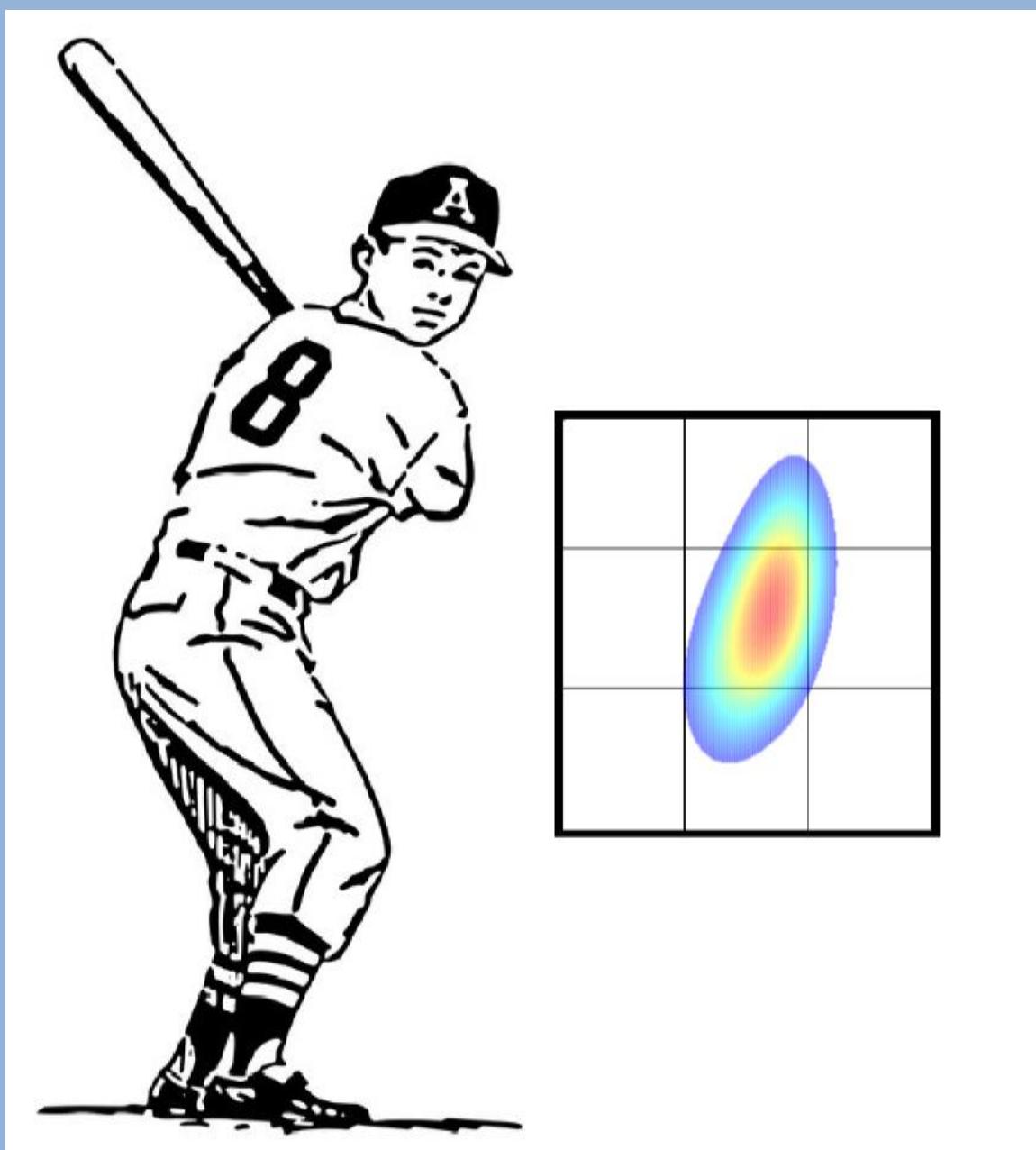
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CONCLUSIONS

A well-developed template is reusable and can be parameterized to accept images with varying dimensions and apply a variety of color models. The applications are numerous. Here are a handful of examples:



REFERENCES

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