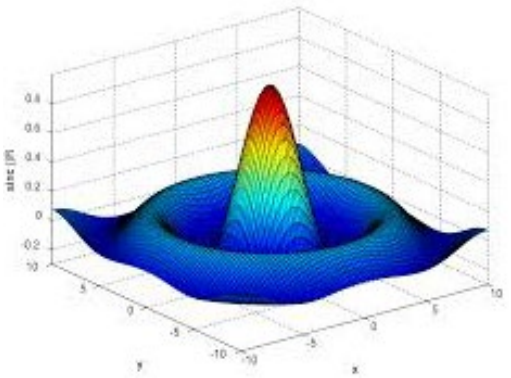
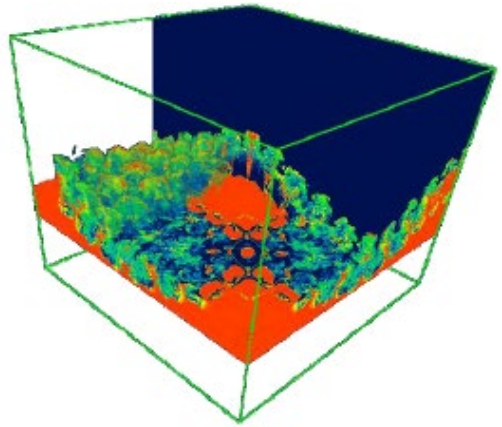
Visualisation Principles 3

Lecture 4 Week 5

Visualisation Summary so far

Data Description		Visualization Examples	
$N^1 \rightarrow R^1$	series of values	bar chart, pie chart, etc.	Covered
$R^1 \rightarrow R^1$	function	graph	
$R^2 \rightarrow R^1$	funct. over R^2	2D-heightfields in 3D, contour lines in 2D	
$R^2 \rightarrow R^2$	2D-vector field	hedgehog plot, LIC, streamlets, etc.	
$R^3 \rightarrow R^1$	3D-Density values	iso-surfaces in 3D, volume rendering	Today Lecture
$N^1 \rightarrow R^n$	tuple quantities (multi-attribute data)	parallel coordinates, glyphs, icons, etc.	





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Multidimensional Visualisation

- Visualisation for $f: R^{d(+1)} \rightarrow R^{e}$, where d>1 and e =1.
  - For demonstration limit to d=2 and d=3.
- Glyph Rendering
  - A glyph is a visual symbol
  - Used to indicate the value of *f* at a point:

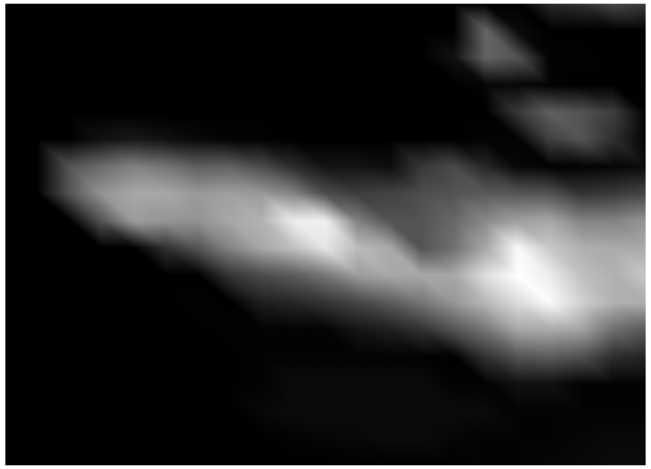
Glyph

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	18	26	21
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	4	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	35	30	1	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	34	30	22	1
0	0	0	6	9	6	3	1	1	0	0	0	0	0	0	1	1	23	30	17	1
0	0	30	39	46	42	34	35	27	16	7	7	5	20	26	14	3	1	1	2	4
0	0	30	53	60	60	55	57	55	47	28	22	24	28	30	32	31	30	19	21	25
0	0	0	30	56	53	52	60	64	85	86	46	30	30	37	49	57	60	47	47	53
0	0	0	0	0	17	30	47	60	69	82	67	61	30	40	60	89	72	63	61	61
0	0	0	0	0	0	0	19	27	33	43	56	60	60	60	80	91	85	69	63	71
0	0	0	0	0	0	1	0	11	14	19	25	33	42	54	66	79	90	75	64	62
0	0	0	0	0	0	0	1	1	1	1	8	11	18	30	42	60	61	58	40	32
0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	18	30	33	29	16	13
0	0	0	0	0	0	0	0	1	4	4	4	4	4	1	1	6	6	1	1	1
0	0	0	0	0	0	0	0	3	4	4	4	4	4	4	4	1	1	1	1	1
0	0	0	0	0	0	0	0	0	1	2	3	4	4	2	1	1	1	2	3	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3	4	4

Multidimensional Visualisation

- Visualisation for $f: R^{d(+1)} \rightarrow R^{e}$, where d>1 and e =1.
  - For demonstration limit to d=2 and d=3.
- Glyph Rendering
  - A glyph is a visual symbol
  - Used to indicate the value of *f* at a point:
    - The value of *f* can be used for Intensity Mapping:

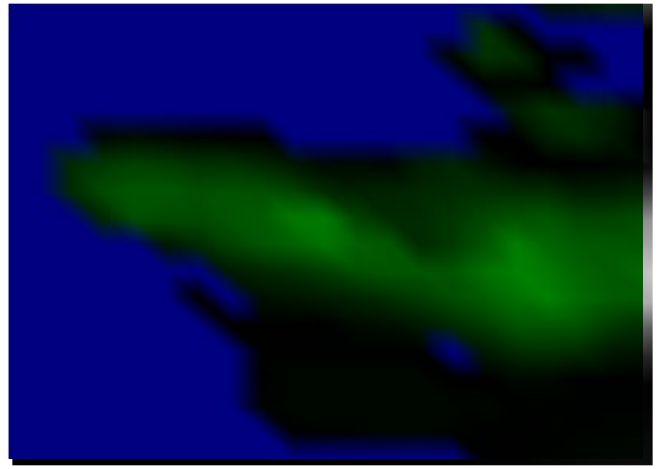
Intensity Mapping



Multidimensional Visualisation

- Visualisation for $f: R^{d(+1)} \rightarrow R^{e}$, where d>1 and e =1.
  - For demonstration limit to d=2 and d=3.
- Glyph Rendering
  - A glyph is a visual symbol
  - Used to indicate the value of *f* at a point:
    - You can also do this in colour, i.e. Colour Mapping:
      - Same idea, but with colours, i.e., t*he value of f determines which color to be used for rendering.*

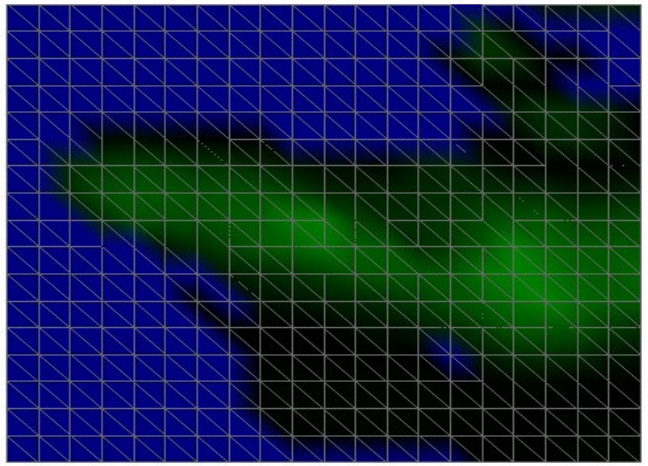
Colour Mapping



Multidimensional Visualisation

- Visualisation for $f: R^{d(+1)} \rightarrow R^{e}$, where d>1 and e =1.
  - For demonstration limit to d=2 and d=3.
- Glyph Rendering
  - A glyph is a visual symbol
  - Used to indicate the value of *f* at a point:
    - You can also do this in colour, i.e. Colour Mapping:
      - Same idea, but with colours
      - Now with Surface Rendering:

Colour Mapping



Multidimensional Visualisation

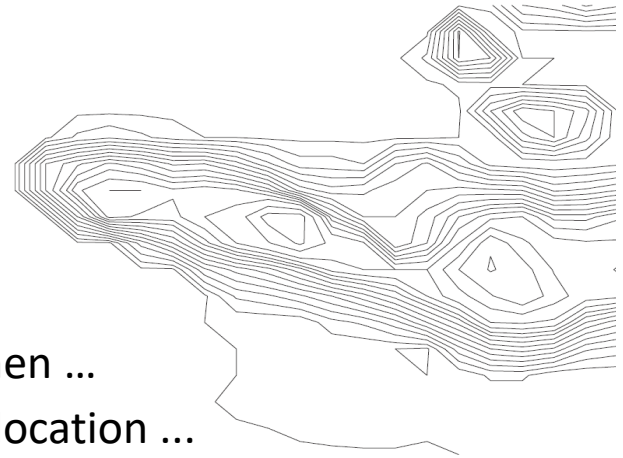
- Visualisation for $f: R^{d(+1)} \rightarrow R^{e}$, where d>1 and e =1.
  - For demonstration limit to d=2 and d=3.
- Glyph Rendering
  - A glyph is a visual symbol
  - Used to indicate the value of *f* at a point:
    - You can do this using Contours for Overhead View:
      - To do so consider a constant value, say "c" (say c=30), then …

      … locate it in your data (*f* ="c"), in its neighborhood find a location ...

      … where *f* ="c" and connect them together with a line, then move to it and continue.

      Note: to find a new place that that *f* ="c", you may need to interpolate between your data in x & y direction.

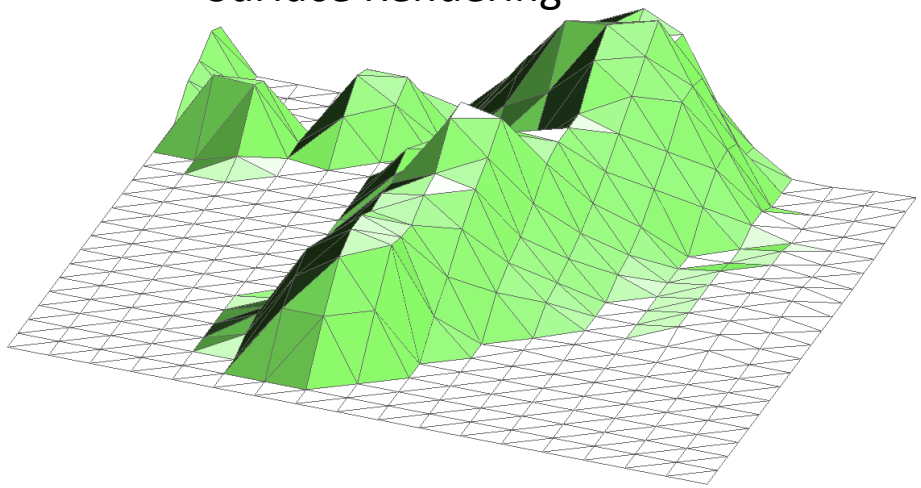
Overhead View



Multidimensional Visualisation

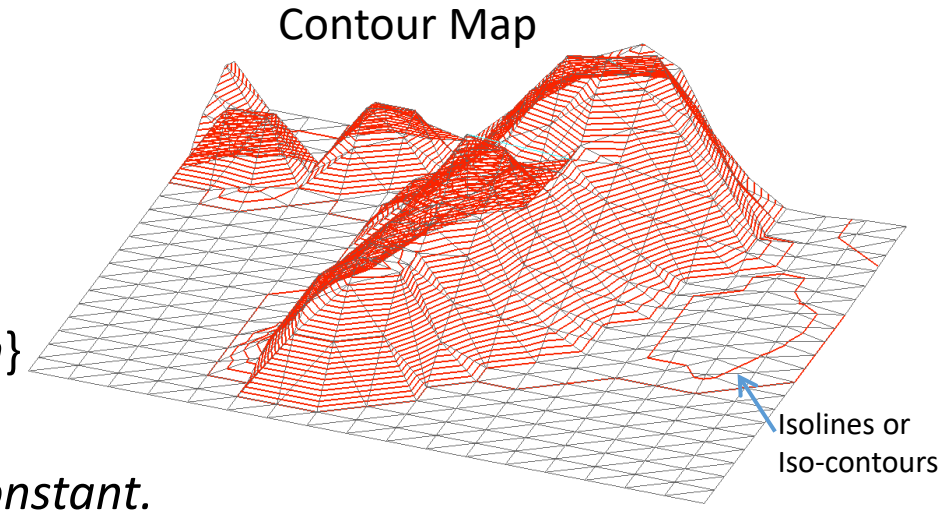
- Visualisation for $f: R^{d(+1)} \rightarrow R^{e}$, where d>1 and e =1.
  - For demonstration limit to d=2 and d=3.
- Surface Rendering
  - **Draw the function as a manifold**
    - Same as before with Glyph and same data
      - rotated for better visualisation
    - Here the height at each point is proportional to value of data at that point.
    - It is up o you how to define the rendering

Surface Rendering



Multidimensional Visualisation

- Visualisation for $f: R^{d(+1)} \rightarrow R^{e}$, where d>1 and e =1.
  - For demonstration limit to d=2 and d=3.
- Surface Rendering
  - **Draw the function as a manifold (Contours)**
  - Contour lines are slices of the data
    - with restriction on data: $f^{-1}(h) = \{(x, y) : f(x, y) = h\}$
    - It is 1-manifolds embedded in 2 or 3 space
    - Isoline consists of (x, y) points that $f(x, y) = h$ *is constant.*
    - Multiple contour lines (isolines) can be shown for constant h-values (isovalues)
    - For d=3, Iso-contours will be Isosurface for a constant isovalues.



Multidimensional Visualisation

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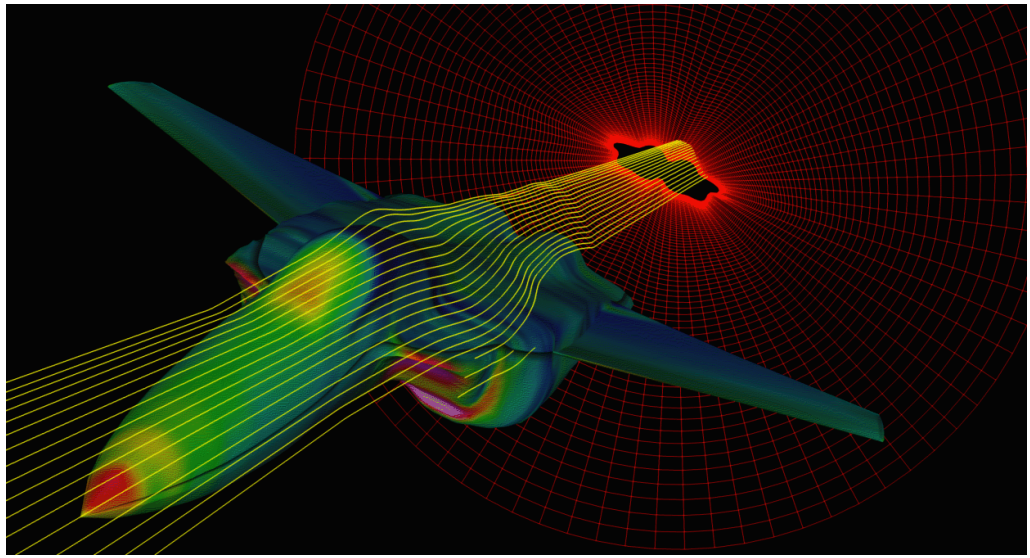
  - For demonstration limit to d=2 and d=3.
- Surface Rendering
  - **Draw the function as a manifold (Contours)**
  - Contour surfaces are slices of the data
    - Data with $f^{-1}(h) = \{(x, y, z) : f(x, y, z) = h\}$
    - For d=3, Iso-contours will be Isosurface for a constant isovalues.
    - i.e., Isosurfaces consists of (x, y, z) points that $f(x, y, z) = h$ *is constant.*



http://cs.swan.ac.uk/~csbob/teaching/csM07-vis/
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Multidimensional Visualisation

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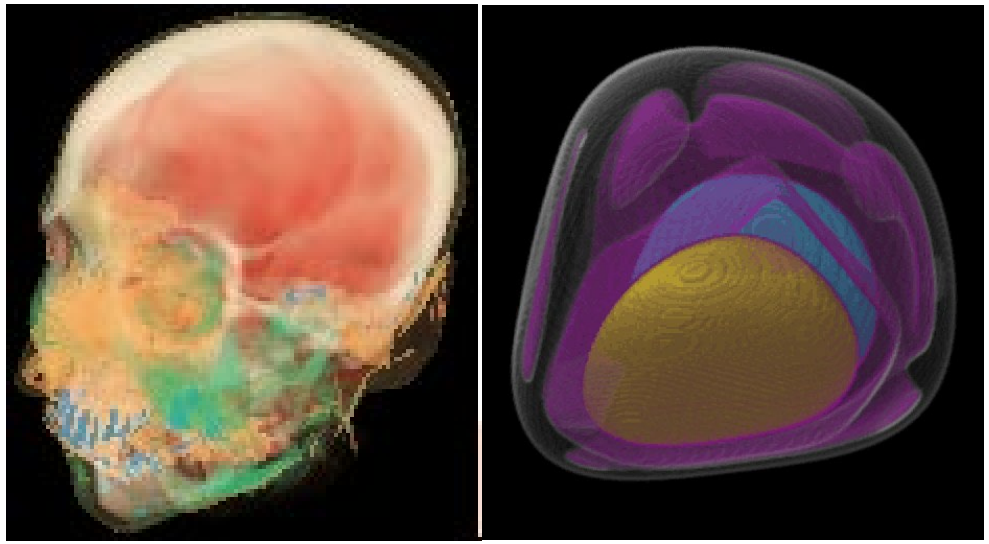

Ament et al., 2010

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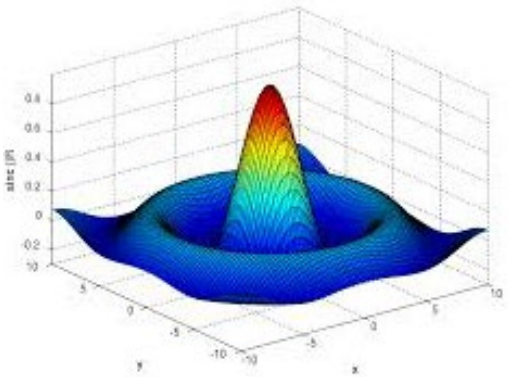

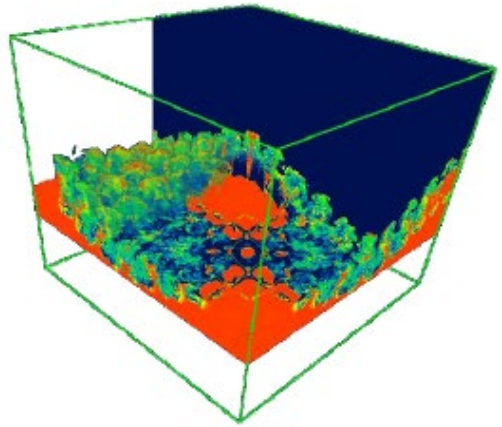

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Thank you