

MSc Computer Games and Entertainment  
Maths & Graphics Unit 2011/12  
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# The Scan Line Algorithm

## Scanline

- **A Scan Line Algorithm for Displaying Parametrically Defined Surfaces**
- James F. Blin 1978

## A Scan Line Algorithm for Displaying Parametrically Defined Surfaces

- This paper presents a scan line algorithm for drawing pictures of parametrically defined surfaces.
- A scan line algorithm is characterized by the order in which it generates the picture elements of the image.
- These are generated left to right, top to bottom in much the same way as a picture is scanned out on a TV screen.

## A Scan Line Algorithm for Displaying Parametrically Defined Surfaces

- Parametrically defined surfaces are those generated by a set of bivariate functions defining the X, Y and Z position of the points on the surface.
- The primary driving mechanism behind such an algorithm is the inversion of the functions used to define the surface.
- To keep the algorithm general enough to apply to a wide variety of functional forms, this inversion is done numerically.
- It is only required to provide a mechanism for evaluating the function and its derivative at any parametric location.

## A Scan Line Algorithm for Displaying Parametrically Defined Surfaces

- The algorithm proceeds in two phases.
- First, a numerical search is made to find the local maxima of the Y definition function within the desired parameter ranges. These determine when portions of the surface first become visible as the scan plane progresses down the screen.
- Secondly, the actual scan conversion process is performed, maintaining a list of segments of the surface intersection the current scan plane.
- As the scan plane passes local maxima of the Y function, new segments are added to the list.

## A Scan Line Algorithm for Displaying Parametrically Defined Surfaces

- In addition, any existing segments are updated to reflect their intersection with the updated scan plane.
- All intersection calculations are performed by a bivariate Newton-Raphson solution of the defining equations.
- If the solution does not converge, it is due to the scan plane passing a local minimum, causing segments to be deleted from the active list.
- Finally within one scan line, an X scan must be performed to generate the Z information about the surface for each picture element.
- This is also performed by a bivariate Newton-Raphson iteration with a different set of defining functions.

**END**