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# Xiaolin Wu's line algorithm

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Please [improve](#) this article by introducing more precise citations. (*January 2013*)

**Xiaolin Wu's line algorithm** is an [algorithm](#) for line [antialiasing](#), which was presented in the article *An Efficient Antialiasing Technique* in the July 1991 issue of *Computer Graphics*, as well as in the article *Fast Antialiasing* in the June 1992 issue of *Dr. Dobbs' Journal*.

[Bresenham's algorithm](#) draws lines extremely quickly, but it does not perform anti-aliasing. In addition, it cannot handle any cases where the line endpoints do not lie exactly on integer points of the pixel grid. A

naive approach to anti-aliasing the line would take an extremely long

time. Wu's algorithm is comparatively fast, but is still slower than [Bresenham's algorithm](#). The algorithm consists of drawing pairs of pixels straddling the line, each coloured according to its distance from the line. Pixels at the line ends are handled separately. Lines less than one pixel long are handled as a special case.

An extension to the algorithm for circle drawing was presented by Xiaolin Wu in the book *Graphics Gems II*. Just like the line drawing algorithm is a replacement for Bresenham's line drawing algorithm, the circle drawing algorithm is a replacement for Bresenham's circle drawing algorithm.



Antialiased line drawn with Xiaolin Wu's algorithm

```
function plot(x, y, c) is
    plot the pixel at (x, y) with brightness c (where 0 ≤ c ≤ 1)

// integer part of x
function ipart(x) is
    return int(x)

function round(x) is
    return ipart(x + 0.5)

// fractional part of x
function fpart(x) is
    if x < 0
        return 1 - (x - floor(x))
    return x - floor(x)

function rfpart(x) is
    return 1 - fpart(x)

function drawLine(x0,y0,x1,y1) is
    boolean steep := abs(y1 - y0) > abs(x1 - x0)

    if steep then
        swap(x0, y0)
        swap(x1, y1)
    end if
    if x0 > x1 then
        swap(x0, x1)
        swap(y0, y1)
    end if

    dx := x1 - x0
    dy := y1 - y0
    gradient := dy / dx

    // handle first endpoint
    xend := round(x0)
```

```

yend := y0 + gradient * (xend - x0)
xgap := rfpart(x0 + 0.5)
xpxl1 := xend // this will be used in the main loop
ypxl1 := ipart(yend)
if steep then
    plot(ypxl1, xpxl1, rfpart(yend) * xgap)
    plot(ypxl1+1, xpxl1, fpart(yend) * xgap)
else
    plot(xpxl1, ypxl1, rfpart(yend) * xgap)
    plot(xpxl1, ypxl1+1, fpart(yend) * xgap)
end if
intery := yend + gradient // first y-intersection for the main loop

// handle second endpoint
xend := round(x1)
yend := y1 + gradient * (xend - x1)
xgap := fpart(x1 + 0.5)
xpxl2 := xend //this will be used in the main loop
ypxl2 := ipart(yend)
if steep then
    plot(ypxl2, xpxl2, rfpart(yend) * xgap)
    plot(ypxl2+1, xpxl2, fpart(yend) * xgap)
else
    plot(xpxl2, ypxl2, rfpart(yend) * xgap)
    plot(xpxl2, ypxl2+1, fpart(yend) * xgap)
end if

// main loop
for x from xpxl1 + 1 to xpxl2 - 1 do
    begin
        if steep then
            plot(ipart(intery), x, rfpart(intery))
            plot(ipart(intery)+1, x, fpart(intery))
        else
            plot(x, ipart(intery), rfpart(intery))
            plot(x, ipart(intery)+1, fpart(intery))
        end if
        intery := intery + gradient
    end
end function

```

## References [[edit](#)]

- Abrash, Michael (June 1992). "Fast Antialiasing (Column)" . *Dr. Dobbs's Journal* **17** (6): 139(7).
- Wu, Xiaolin (July 1991). "An efficient antialiasing technique" . *Computer Graphics* **25** (4): 143–152. doi:10.1145/127719.122734 . ISBN 0-89791-436-8.
- Wu, Xiaolin (1991). "Fast Anti-Aliased Circle Generation". In James Arvo (Ed.). *Graphics Gems II*. San Francisco: Morgan Kaufmann. pp. 446–450. ISBN 0-12-064480-0.

## External links [[edit](#)]

- Xiaolin Wu's homepage
- Matlab algorithm

Categories: Computer graphics algorithms

This page was last modified on 1 March 2015, at 00:27.

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