
Subject: Re: Polygon Clipping Algo in IDL

Posted by [Mark Hadfield](#) on Tue, 13 Dec 2005 01:38:42 GMT

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raval.chintan@gmail.com wrote:

> Dear All,

>

> Does any one has written code for the polygon clipping (Cohen
> Sutherland or Liang Baskey) in IDL? or is there any direct function
> available in IDL?

>

> Regards

> Chintan

>

Attached, based on code from JD Smith. These are part of my Motley
library and may well require other routines in same. See

<http://www.dfanning.com/hadfield/idl/README.html>

--

Mark Hadfield "Kei puwaha te tai nei, Hoesa tahi tatou"

m.hadfield@niwa.co.nz

National Institute for Water and Atmospheric Research (NIWA)

```
;+
; NAME:
;   MGH_POLYCLIP
;
; PURPOSE:
;   Clip an arbitrary polygon on the X-Y plane to a line parallel
;   to the X or Y axis using the Sutherland-Hodgman algorithm.
;
; CATEGORY:
;   Graphics, Region of Interest, Geometry
;
; CALLING SEQUENCE:
;   result = MGH_POLYCLIP(clip, dir, neg, polin, COUNT=count)
;
; RETURN VALUE
;   The function returns the clipped polygon as a [2,n] array. The
;   second dimension will equal the value of the COUNT argument, except
;   where COUNT is 0 in which case the return value is -1.
;
; POSITIONAL PARAMETERS
;   cval (input, numeric scalar)
;     The value of X or Y at which clipping is to occur
;
```

```

; dir (input, integer scalar)
;   Specifies whether clipping value is an X (dir = 0) or Y (dir =
;   1) value.
;
; neg (input, integer scalar)
;   Set this argument to 1 to clip to the negative side, 0 to clip to
;   the positive side.
;
; polin (input, floating array)
;   A [2,m] vector defining the polygon to be clipped.
;
; KEYWORD PARAMETERS
;   COUNT (output, integer)
;     The number of vertices in the clipped polygon.
;
; PROCEDURE:
;   The polygon is clipped using the Sutherland-Hodgman algorithm.
;
;   This function is based on JD Smith's implementation of the
;   Sutherland-Hodgman algorithm in his POLYCLIP function. He can
;   take all of the credit and none of the blame.
;
; #####
;
; This software is provided subject to the following conditions:
;
; 1. NIWA makes no representations or warranties regarding the
;    accuracy of the software, the use to which the software may
;    be put or the results to be obtained from the use of the
;    software. Accordingly NIWA accepts no liability for any loss
;    or damage (whether direct or indirect) incurred by any person
;    through the use of or reliance on the software.
;
; 2. NIWA is to be acknowledged as the original author of the
;    software where the software is used or presented in any form.
;
; #####
;
; MODIFICATION HISTORY:
;   Mark Hadfield, 2001-10:
;     Written, based on JD Smith's POLYCIIP.
;
; -

```

```
function mgh_polyclip, cval, dir, neg, poly, COUNT=count
```

```

  compile_opt DEFINT32
  compile_opt STRICTARR
  compile_opt STRICTARRSUBS

```

```

compile_opt LOGICAL_PREDICATE

if n_elements(poly) eq 0 then $
    message, BLOCK='mgh_mblk_motley', NAME='mgh_m_undefvar', 'poly'

;; If the polygon argument is a scalar then return a scalar to
;; to indicate that the polygon has no vertices.

count = 0

if size(poly, /N_DIMENSIONS) eq 0 then return, -1

;; Vector "in" specifies whether each vertex is inside
;; the clipped half-plane

case dir of
    0B: in = neg ? reform(poly[0,*] lt cval) : reform(poly[0,*] gt cval)
    else: in = neg ? reform(poly[1,*] lt cval) : reform(poly[1,*] gt cval)
endcase

;; Calculate number of points in polygon--it is a little
;; more efficient to get it from the size of "in" than
;; from the dimensions of "poly"

np = n_elements(in)

;; Vector "inx" specifies whether an intersection with the clipping line
;; is made by the segment joining each vertex with the one before.

inx = in xor shift(in, 1)

;; Precalculate an array of shifted vertices, used in calculating
;; intersection points in the loop.

pols = shift(poly, 0, 1)

;; Loop thru vertices

for k=0,np-1 do begin

    ;; If this segment crosses the clipping line, add the intersection
    ;; to the output list. I tried calculating the intersection points
    ;; outside the loop in an array operation but it turned out slower.

    if inx[k] then begin
        s0 = pols[0,k]
        s1 = pols[1,k]
        p0 = poly[0,k]
    end
end

```

```

    p1 = poly[1,k]
    case dir of
      0B: ci = [cval,s1+(p1-s1)/(p0-s0)*(cval-s0)]
      else: ci = [s0+(p0-s0)/(p1-s1)*(cval-s1),cval]
    endcase
    polout = count eq 0 ? [ci] : [[polout],[ci]]
    count ++
  endif

;; If this vertex is inside the clipped half-plane add it to the list

if in[k] then begin
  polout = count eq 0 ? [poly[*,k]] : [[polout],[poly[*,k]]]
  count ++
endif

endfor

return, count gt 0 ? polout : -1

end

;+
; NAME:
;   MGH_POLYCLIP2
;
; PURPOSE:
;   Clip an arbitrary polygon on the X-Y plane to a line of arbitrary
;   orientation using the Sutherland-Hodgman algorithm.
;
; CATEGORY:
;   Graphics, Region of Interest, Geometry
;
; CALLING SEQUENCE:
;   result = MGH_POLYCLIP2(clip, poly, COUNT=count)
;
; POSITIONAL PARAMETERS
;   poly (input, floating array)
;     A [2,m] vector defining the polygon to be clipped.
;
;   clip (input, 3-element numeric vector)
;     This parameter describes the line to be clipped to. The polygon is
;     clipped to the half-plane (clip[0] x + clip[1] y + clip[2]) < 0.
;
; KEYWORD PARAMETERS
;   COUNT (output, integer)
;     The number of vertices in the clipped polygon.
;
;
```

```

; RETURN VALUE
; The function returns the clipped polygon as a [2,n] array. The
; second dimension will equal the value of the COUNT argument, except
; where COUNT is 0 in which case the return value is -1.
;
;
; PROCEDURE:
; The polygon is clipped using the Sutherland-Hodgman algorithm.
;
;
; This function is similar to MGH_POLYCLIP, which was written first
; & clips to vertical or horizontal lines only. It turns out that
; MGH_POLYCLIP2 is competitive with MGH_POLYCLIP in terms of speed
; so the former may supersede the latter.
;
;
; Both polygon-clipping functions are based on JD Smith's
; implementation of the Sutherland-Hodgman algorithm in his POLYCLIP
; function. He can take most of the credit and none of the blame.
;
;
; #####
;
; This software is provided subject to the following conditions:
;
;
; 1. NIWA makes no representations or warranties regarding the
; accuracy of the software, the use to which the software may
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; through the use of or reliance on the software.
;
;
; 2. NIWA is to be acknowledged as the original author of the
; software where the software is used or presented in any form.
;
;
; #####
;
; MODIFICATION HISTORY:
; Mark Hadfield, 2002-08:
; Written.
;
; -

```

```

function mgh_polyclip2, poly, clip, COUNT=count

```

```

    compile_opt DEFINT32
    compile_opt STRICTARR
    compile_opt STRICTARRSUBS
    compile_opt LOGICAL_PREDICATE

```

```

    if size(poly, /N_ELEMENTS) eq 0 then $
        message, BLOCK='mgh_mblk_motley', NAME='mgh_m_undefvar', 'poly'

```

```

if size(clip, /N_ELEMENTS) ne 3 then $
    message, BLOCK='mgh_mblk_motley', NAME='mgh_m_wrgnumelem', 'clip'

;; If the polygon argument is a scalar then return a scalar to
;; to indicate that the polygon has no vertices.

count = 0

if size(poly, /N_DIMENSIONS) eq 0 then return, -1

;; Precalculate an array of shifted vertices, used in calculating
;; intersection points in the loop.

pols = shift(poly, 0, 1)

;; Vector "pp" is the position of each vertex along the
;; perpendicular to the clipping line. Vector "ps" is the same for
;; the shifted vertices

pp = reform(clip[0]*poly[0,*]+clip[1]*poly[1,*]+clip[2])
ps = shift(pp, 1)

;; Vector "in" specifies whether each vertex is inside the clipped
;; half-plane. Vector "inx" specifies whether an intersection with
;; the clipping line is made by the segment joining each vertex
;; with the one before.

in = pp lt 0
inx = in xor (ps lt 0)

;; Loop thru vertices

np = n_elements(in)

for k=0,np-1 do begin

    ;; If this segment crosses the clipping line, add the
    ;; intersection to the output list.

    if inx[k] then begin
        ap = ps[k]/(ps[k]-pp[k])
        ci = ap*poly[* ,k] + (1-ap)*pols[* ,k]
        polout = count eq 0 ? [ci] : [[polout],[ci]]
        count ++
    endif

    ;; If this vertex is inside the clipped half-plane add it to the
    ;; list

```

```
if in[k] then begin
    polout = count eq 0 ? [poly[*,k]] : [[polout],[poly[*,k]]]
    count ++
endif
```

```
endfor
```

```
return, count gt 0 ? polout : -1
```

```
end
```

File Attachments

- 1) [mgh_polyclip.pro](#), downloaded 116 times
 - 2) [mgh_polyclip2.pro](#), downloaded 112 times
-

Subject: Re: Polygon Clipping Algo in IDL
Posted by [JD Smith](#) on Tue, 13 Dec 2005 16:32:58 GMT
[View Forum Message](#) <> [Reply to Message](#)

On Tue, 13 Dec 2005 14:38:42 +1300, Mark Hadfield wrote:

```
> raval.chintan@gmail.com wrote:
>> Dear All,
>>
>> Does any one has written code for the polygon clipping ( Cohen
>> Sutherland or Liang Baskey ) in IDL? or is there any direct function
>> available in IDL?
>>
>> Regards
>> Chintan
>>
> Attached, based on code from JD Smith. These are part of my Motley library
> and may well require other routines in same. See
```

Hey Mark... remind me what your version did different from mine? I recall spending weeks trying to vectorize this algorithm, only to give up and write it as a DLM. It's fairly slow in IDL. Lately I've been exploring the clipping library GPC, linking it as a DLM.

JD

Subject: Re: Polygon Clipping Algo in IDL
Posted by [Mark Hadfield](#) on Tue, 13 Dec 2005 23:02:17 GMT
[View Forum Message](#) <> [Reply to Message](#)

JD Smith wrote:

> On Tue, 13 Dec 2005 14:38:42 +1300, Mark Hadfield wrote:

>

> Hey Mark... remind me what your version did different from mine? I recall

> spending weeks trying to vectorize this algorithm, only to give up and

> write it as a DLM. It's fairly slow in IDL. Lately I've been exploring

> the clipping library GPC, linking it as a DLM.

It's been a while. Didn't your POLYCLIP clip to a square? Whereas my routines clip to a single line (must be parallel to the X or Y axis for MGH_POLYCLIP and of arbitrary orientation for MGH_POLYCLIP2). Clipping to a square or rectangle therefore requires 4 applications. I settled on the line-clipping functions because they are more general and applying them 4 times is not significantly slower than applying a rectangle-clipping form once.

I spent a fair bit of time tweaking the code and achieved a modest speed-up over the code you sent me (perhaps 2x). The thing that made the difference was converting a couple of functions into in-line code.

I actually wanted this code for the following situation: I have a 2D grid of cells (usually rectangular, sometimes curvilinear) and some polygons which, for the sake of argument, we can consider to be land areas. For each cell in the grid, I want the fraction that is inside one of the polygons. So for each cell I clip every polygon and calculate the area (if any) in the clipped polygon. This approach is *not* particularly fast and implementing the polygon clipping in IDL slows it down further. I'm sure DLM-ed C code would be faster and am interested in your results.

--

Mark Hadfield "Kei puwaha te tai nei, Hoea tahi tatou"

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National Institute for Water and Atmospheric Research (NIWA)

Subject: Re: Polygon Clipping Algo in IDL

Posted by [JD Smith](#) on Wed, 14 Dec 2005 19:01:54 GMT

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On Wed, 14 Dec 2005 12:02:17 +1300, Mark Hadfield wrote:

> JD Smith wrote:

>> On Tue, 13 Dec 2005 14:38:42 +1300, Mark Hadfield wrote:

>>

>> Hey Mark... remind me what your version did different from mine? I

>> recall spending weeks trying to vectorize this algorithm, only to give

>> up and write it as a DLM. It's fairly slow in IDL. Lately I've been
>> exploring the clipping library GPC, linking it as a DLM.
>
> It's been a while. Didn't your POLYCLIP clip to a square? Whereas my
> routines clip to a single line (must be parallel to the X or Y axis for
> MGH_POLYCLIP and of arbitrary orientation for MGH_POLYCLIP2). Clipping to
> a square or rectangle therefore requires 4 applications. I settled on the
> line-clipping functions because they are more general and applying them 4
> times is not significantly slower than applying a rectangle-clipping form
> once.

That sounds about right.

> I spent a fair bit of time tweaking the code and achieved a modest
> speed-up over the code you sent me (perhaps 2x). The thing that made the
> difference was converting a couple of functions into in-line code.

I did the same thing, and got a similar speedup. I also lobbied for
RSI to give us a high-speed parallel polygon clipper as a native
routine. They thought about it a bit. My final tool is called
POLYFILLAA, which, like POLYFILLV, computes clipped pixels inside a
polygon, but unlike POLYFILLV, gives you the area of the pixel which
was clipped, and can (optionally) return the clipped pixel polygon
itself (AA stands for "anti-aliasing").

> I actually wanted this code for the following situation: I have a 2D
> grid of cells (usually rectangular, sometimes curvilinear) and some
> polygons which, for the sake of argument, we can consider to be land
> areas. For each cell in the grid, I want the fraction that is inside one
> of the polygons. So for each cell I clip every polygon and calculate the
> area (if any) in the clipped polygon. This approach is *not*
> particularly fast and implementing the polygon clipping in IDL slows it
> down further. I'm sure DLM-ed C code would be faster and am interested
> in your results.

I'll send you the code offline. I actually use a clever method of
auto-compiling the C code using MAKE_DLL, and if that fails, falling
back on the slower IDL code. I'm not actually using a DLM, just
CALL_EXTERNAL (which is probably slower for lots of small polygon
clips), but I do get another factor of 3 or so speedup. I toyed with
encoding GPC as a DLM, and stuffing much larger numbers of polygons
down its throat at once, for (I expect) another much larger speedup,
but that still on the TODO list. The main annoyance is encoding all
of the variously sized resultant pixel polygons on return. A
reverse-indices type setup should work.

