
Subject: Re: 2D Savitzky-Golay derivative filter?
Posted by [dg86](#) on Thu, 07 Feb 2013 02:19:01 GMT
[View Forum Message](#) <> [Reply to Message](#)

Dear Folks,

I append a routine that computes two-dimensional Savitzky-Golay filters for smoothing and taking derivatives of images. This is based substantially on Erik Rosolowsky's `savgol2d()` routine, with some code simplification and the addition of capabilities for computing derivatives of specified order along each direction.

The benefit of Savitzky-Golay filters for image analysis is that they suppress noise while retaining features of interest such as peaks and ridges. They therefore are particularly useful for computing gradients of images with additive noise.

Comments and suggestions are warmly solicited.

All the best,

David

```
;+
; NAME:
;   savgol2d()
;
; PURPOSE:
;   Calculate two-dimensional Savitzky-Golay filters for smoothing images or
;   computing their derivatives.
;
; CALLING SEQUENCE:
;   filter = savgol2d(dim, order)
;
; INPUTS:
;   dim: width of the filter [pixels]
;   order: The degree of the polynomial
;
; KEYWORD PARAMETERS:
;   dx: order of the derivative to compute in the x direction
;       Default: 0 (no derivative)
;   dy: order of derivative to compute in the y direction
;       Default: 0 (no derivative)
;
; OUTPUTS:
;   filter: [dim,dim] Two-dimensional Savitzky-Golay filter
;
; EXAMPLE:
; IDL> dadx = convol(a, savgol2d(11, 6, dx = 1))
;
```

```
; MODIFICATION HISTORY:
; Algorithm based on SAVGOL2D:
; Written and documented
; Fri Apr 24 13:43:30 2009, Erik Rosolowsky <erosolo@A302357>
;
; 02/06/2013 Revised version by David G. Grier, New York University
;-
```

```
function savgol2d, dim, order, dx = dx, dy = dy
```

```
COMPILE_OPT IDL2
```

```
umsg = 'USAGE: filter = dgsavgol2d(dim, order)'
```

```
if n_params() ne 2 then begin
```

```
    message, umsg, /inf
```

```
    return, -1
```

```
endif
```

```
if ~isa(dim, /scalar, /number) then begin
```

```
    message, umsg, /inf
```

```
    message, 'DIM should be the integer width of the filter', /inf
```

```
    return, -1
```

```
endif
```

```
if ~isa(order, /scalar, /number) then begin
```

```
    message, umsg, /inf
```

```
    message, 'ORDER should be the integer order of the interpolating polynomial', /inf
```

```
    return, -1
```

```
endif
```

```
if ~(order lt dim) then begin
```

```
    message, umsg, /inf
```

```
    message, 'ORDER should be less than DIM', /inf
```

```
    return, -1
```

```
endif
```

```
if ~isa(dx, /scalar, /number) then dx = 0
```

```
if ~isa(dy, /scalar, /number) then dy = 0
```

```
if dx lt 0 or dy lt 0 then begin
```

```
    message, umsg, /inf
```

```
    message, 'DX and DY should be non-negative integers', /inf
```

```
    return, -1
```

```
endif
```

```
if (dx + dy ge order) then begin
```

```
    message, umsg, /inf
```

```
    message, 'DX + DY should not be greater than ORDER', /inf
```

```
    return, -1
```

```
endif
```

```

npts = dim^2

x = rebin(findgen(dim)-dim/2, dim, dim)
y = transpose(x)
x = reform(x, npts)
y = reform(y, npts)

Q = findgen((order+1)*(order+2)/2, npts)

n = 0
for nu = 0, order do begin
  ynu = y^nu
  for mu = 0, order-nu do begin
    Q[n++, *] = x^mu * ynu
  endfor
endfor

a = transpose(invert(Q # transpose(Q)) # Q)
filter = fltarr(npts)
b = [1., fltarr(npts-1)]
ndx = dx + (order + 1) * dy
for i = 0, npts-1 do begin
  filter[i] = (a ## b)[ndx]
  b = shift(b, 1)
endfor

return, reform(filter, dim, dim)
end

```
