

Simpson's 3/8 method between application and derivation in medical image processing

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Abstract: In medical image processing, the area nozzles in the plancton of Mars and the space of agricultural areas. The method used to find the area of an irregular shape is by dividing it into a group of arcs or lines, finding the area under each line, and then performing arithmetic operations such as addition and subtraction. Arcs or lines can be divided into two basic classes: The first category is the lines or arcs in which the area calculated by the proposed integration is added. While the second category can be described by the lines that subtract the area below from the total area, These divisions were made by tracing the values of points on the horizontal axis in terms of increasing and decreasing. In the event of any reversal of the situation. The state of the line is inverted from addition to subtraction or vice versa.

Keywords: Simpson's 3/8 and Matlab coud

1. INTRODUCTION

Basic Revive mathematical integration

The following is a general formulation of the numerical integration problem:

an assortment of data points $((x_0, g_0), (x_1, g_1), \dots, (x_n, g_n))$ of a purpose $h = f(x)$, where $f(x)$ It is necessary to calculate the definite integral's value as follows:

$$I = \int_a^b g(x)dx \quad (1)$$

One replaces the other, just like in the case of numerical differentiation. $f(x)$ by a polynomial interpolator. $\Phi(x)$ and succeeds on integration a rough estimate obtained depending upon the type of the interpolation Depending on the interpolation formula utilized, formulas can be produced. Using Newton's forward difference formula, a general formula for numerical integration will be derived in this section. [21]

Let's divide the range [a, b] into n equal subranges so that

$$a = x_0 < x_1 < x_2 < x_3 < \dots < x_n = b. \text{ Clearly, } x_n = x_0 + nh.$$

The integral follows.

$$I = \int_{x_0}^{x_n} g(x)dx \quad (2)$$

Approximating $f(x)$ Newton's forward difference formula yields the following:

$$I = \int_{x_0}^{x_1} h[g_0 + u\Delta g_0 + \frac{u(u-1)}{2!}\Delta^2 g_0 + \frac{u(u-1)(u-2)}{3!} + \dots] dx \quad (3)$$

Since $x = x_0 + uh$, $dx = hdu$ and as a result, the above integral is:

$$I = h \int_0^n [g_0 + u\Delta g_0 + \frac{u(u-1)}{2!}\Delta^2 g_0 + \frac{u(u-1)(u-2)}{3!}\Delta^3 g_0 + \dots] du \quad (4)$$

which focuses on simplifying

$$\int_{x_0}^{x_n} g(x)dx = nh[g_0 + \frac{n}{2}\Delta g_0 + \frac{n(2n-3)}{12}\Delta^2 g_0 + \frac{n(n-2)^2}{24} + \Delta^3 g_0 + \dots] \quad (5)$$

Using this basic formula By entering $n = 1, 2, 3, \dots$, etc, we can get several integration equations. Some of these formulas, like the trapezoidal and Simpson's 1/3-rules, which are determined to have sufficient precision to be applied in real-world situations, can be derived here [19].

With $n = 3$, we can see that any differences higher than the third will be zero in Eq. (1.5), and the integral will then be [22].

$$\begin{aligned} \int_{x_0}^{x_3} g dx &= 3h[g_0 + \frac{3}{2}\Delta g_0 + \frac{3}{4}\Delta^2 g_0 + \frac{1}{8}\Delta^3 g_0] \\ &= 3h[g_0 + \frac{3}{2}(g_1 - g_0) + \frac{3}{4}(g_2 - 2g_1 + g_0) + \frac{1}{8}(g_3 + 3g_2 + 3g_1 - g_0)] \\ &= \frac{3h}{8}(g_0 + 3g_1 + 3g_2 + g_3) \end{aligned} \quad (6)$$

Similarly

$$\int_{x_3}^{x_6} g dx = \frac{3h}{8} [g_3 + 3g_4 + 3g_5 + g_6]$$

And so on. Summing up all these integral formulas, we obtain:

$$\int_{x_0}^{x_n} g dx = \frac{3h}{8} [(g_0 + 3g_1 + 3g_2 + g_3) + (g_3 + 3g_4 + 3g_5 + g_6) + \dots (g_{n-3} + 3g_{n-2} + 3g_{n-1} + g_n)]$$

$$= \frac{3h}{8} (g_0 + 3g_1 + 3g_2 + 2g_3 + 3g_4 + 3g_5 + 2g_6 + \dots + 2g_{n-3} + 3g_{n-2} + 3g_{n-1} + g_n)$$

(7)

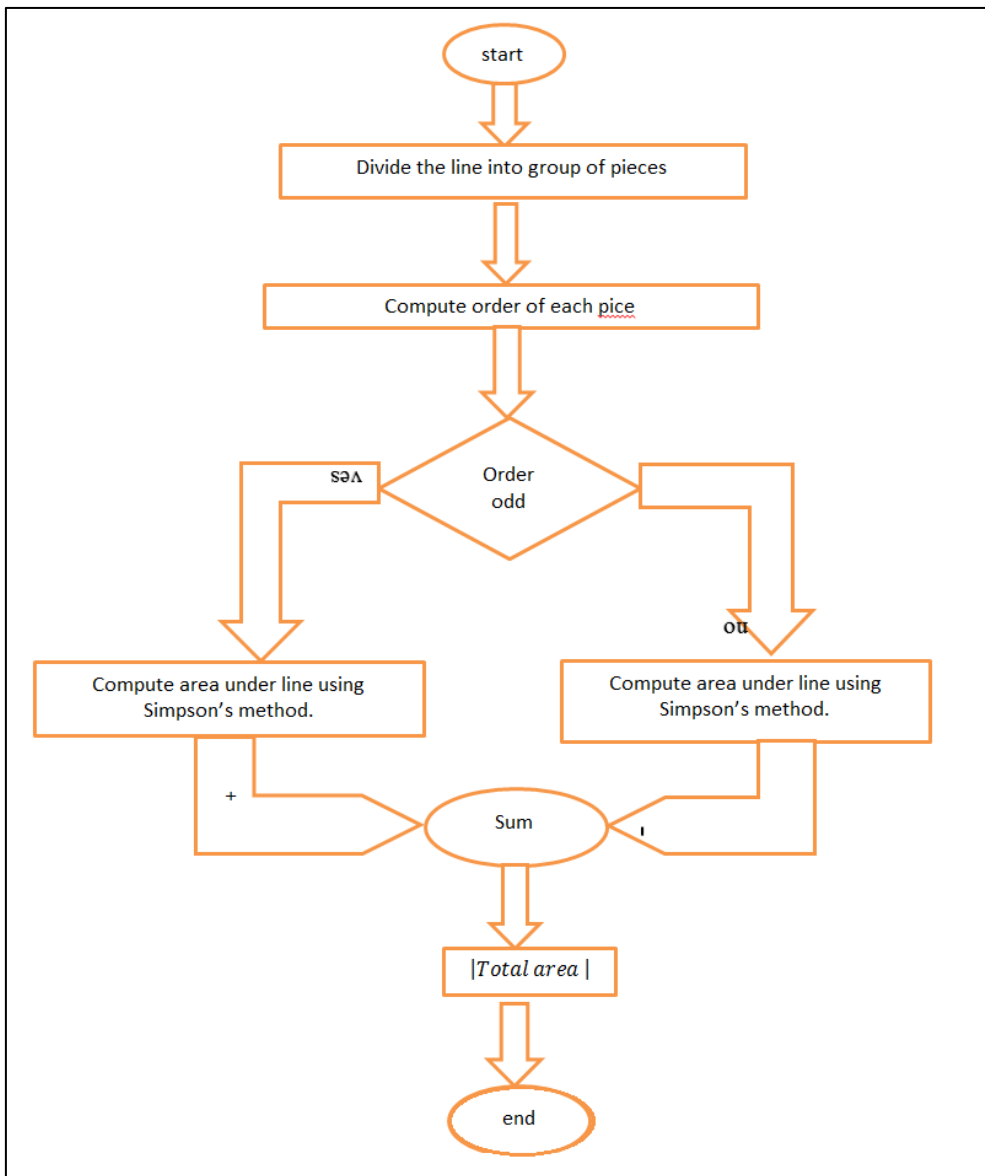
This rule, often known as Simpson's (3/8) rule, is not quite as precise.

The primary term in this formula's inaccuracy is

$$Err(\bar{x}) = \left(\frac{3}{80}\right) h^5 g^{iv}(\bar{x}) \tag{8}$$

2- Matlab Algorithm.

Working algorithm calcation of Dental series Area



3. Determining and calculating the area of tooth decay

The purpose of this application is to build a program that deals with medical images whose area is difficult to calculate [3]. After determining the caries area, taking a picture of the caries area, determining it with points on the edges of the image with the mouse, and then calculating the decay area for the irregular shape according to Figure No. 1,

And Figure No. 2 by applying the Simpson method 1/3 or the proposed method for calculating the area as shown in the following examples [15].

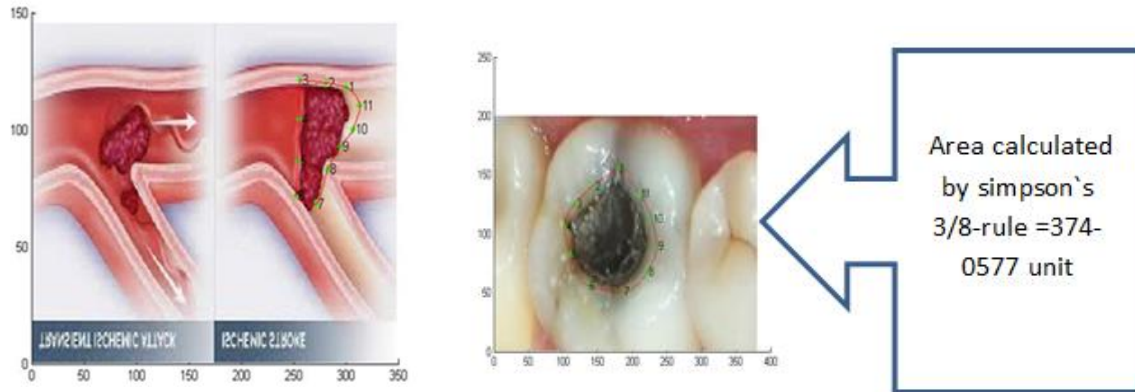


Fig (1)

4- Determine the thrombus area in the artery.

determining and calculating the arterial thrombus area and the area of pneumonia.

The purpose of this application is to build a program that deals with medical images as well. The area of which is difficult to calculate using the usual methods [3] after taking a picture of the blood clot in the artery by using colored rays through which it is possible to identify or locate the clot. Also, a picture of the pneumonia of the infected person can be taken. Determining

the area of inflammation through which the poor pathological condition can be known, after locating the edges of the image with points of irregular shape, and then the area can be calculated by applying the Simpson 3/8 method or the proposed method for calculating the area as shown in the following examples [13].

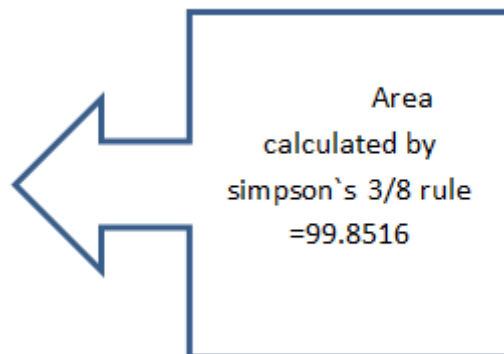


Fig (2)

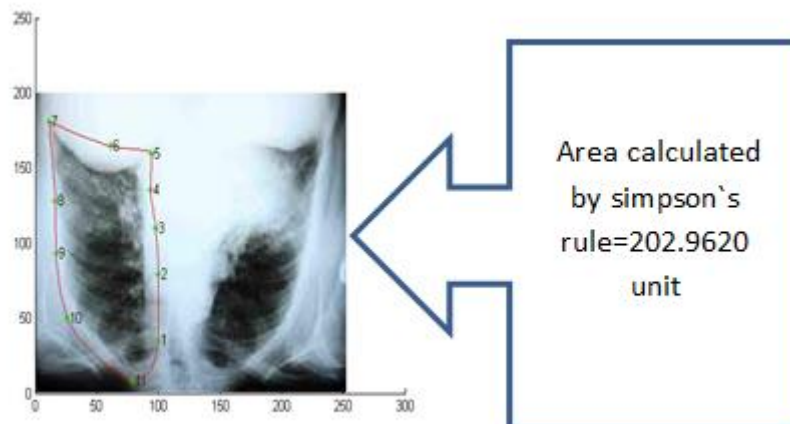


Fig (3)

2-3 Matlab coud.

The area of irregular shapes in images can be calculated using Simpson's octet equation. It is worth noting that Simpson's eight equation is usually used to divide curved areas into small parts and calculate the area of each part, and it is one of the most common methods for calculating areas in mathematics and engineering. To apply Simpson's eight equations to irregular images, a mathematical computing program such as Matlab can be used.

```

clc ;
clear ;
close all ;
clf
hold on
z=imread('p5.jpg');
image(z);
grid
echo on

x = []; y = []; n = 0; % Loop, picking up the points.
but = 1;
echo off;
while but == 1
    [xi,yi,but] = ginput(1);
    if length(but)==0
        if n<2
            but=1;
            disp('Pick at least two points please.')
        else
            but=2;
        end
    elseif but~=1
        if n<11
            but=1;
            disp('Pick at least two points please.')
        end
    end
    plot(xi,yi,'g*')
    grid
    n = n + 1;
    text(xi,yi,[' ' int2str(n)],'Erase','back');
    x = [x; xi];
    y = [y; yi];
end
end
echo on;
disp('End of data entry')
% pause

clc
n=n+1;
x = [x; x(1)];
y = [y; y(1)];
% Interpolate the points with two splines
t = 1:n;
ts = 1:1/10:n;
xs = pchip(t,x,ts);
ys = pchip(t,y,ts);
% pause

% xs = [xs xs(1)];
% ys = [ys ys(1)];
% Plot the interpolated curve.
plot(xs,ys,'r-');

```

```

NoOfLevels=1;
inv =0;
cornars=[];
for i=2:length(xs)

    if xs(i)<xs(i-1) && inv==0
        NoOfLevels = NoOfLevels+1;
        inv=1;
        cornars =[cornars i];
    elseif xs(i)>xs(i-1)&& inv==1
        NoOfLevels = NoOfLevels+1;
        inv=0;
        cornars =[cornars i];
    end
end
area=0;

for j=1:NoOfLevels
    if j==1
        a=xs(1);
        b=xs(cornars(1));
        fun= ys(1:cornars(1));
    elseif j==NoOfLevels
        a=xs(cornars(j-1)+1);
        b=xs(end);
        fun= ys(cornars(j-1)+1:end);
    else
        a=xs(cornars(j-1)+1);
        b=xs(cornars(j));
        fun= ys(cornars(j-1)+1:cornars(j));
    end

    IS_EVEN = ~mod(j,2);
    if IS_EVEN ==0
        area = area + simpsons(fun,a,b,[]);
    else
        area = area - simpsons(flip(fun),b,a,[]);
    end
end

end
% area=abs(trapz(xs,ys));
echo off
hold off
disp('End')

```

5. CONCLUSION:

The research aims to develop a program that deals with medical images and calculates the area of those images in a simple way using the calculator after determining [9] the dimensions of those images on an axis x and an axis y, then calculating the area of the irregular shape after relying on the Simpson 3/8 method. Which is considered one of the methods of numerical integration with high accuracy in calculating the area of the irregular shape and an error rate less than the method of the trapezoid, which is considered one of the primitive methods in calculating the values of numerical integrations, as well as any other method of numerical integration. Methods can be added to the program that calculates the area by specifying points with the mouse for irregular shapes and dimensions. The image whose area is to be calculated.

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