MicrUs and MicrUs Pro Series Ultrasound Systems

Echo Wave A Software

Measurements and Calculations Reference Manual

TELEMED

Ultrasound Medical Systems

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Content

Echo Wave A Software Measurements and Calculations Overview

This document presents equations that are used for Echo Wave A measurements and calculations.

- B mode measurements and calculations

  Distance
  Area (method: 1 ellipse)
  Circumference (method: 1 ellipse)
  Volume (method: 1 ellipse)

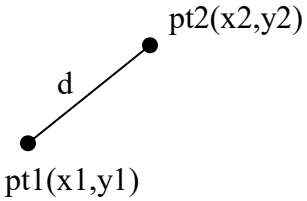
- M mode measurements and calculations

  Distance
  Time
  Velocity
  Heart Rate (method: 2 beats distance)

1 B mode general measurements and calculations

In this section are presented basic equations that are used both for general measurements and calculations. **Please note that not all here described measurements may have control items in software user interface, but they may be used in other calculations.**

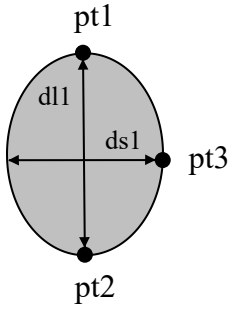
1.1 B Distance



Distance d between points pt1 and pt2 is calculated using the following equation:

$$d(pt1, pt2) = \sqrt{(x1 - x2)^2 + (y1 - y2)^2} .$$

1.2 B Area (Ellipse)

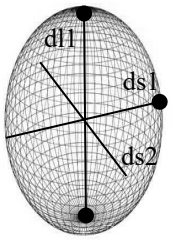


During measurements and calculations we assume that ellipse axis between two circular marker points pt1 and pt2 is "long axis", and axis with one circular endpoint marker pt3 is "short axis". And this "long axis" and "short axis" notation remains unchanged no matter what are real lengths of these axes.

Area S and circumference P (perimeter) of an ellipse with long axis length dl1 and short axis length ds1 are calculated using the following equations:

$$S = \frac{\pi \cdot dl1 \cdot ds1}{4}, \; P = \pi \cdot \sqrt{\frac{1}{2}\left((dl1)^2 + (ds1)^2\right)}.$$

Volume V of an ellipsoid with axes lengths dl1, ds1, and ds2=ds1 is calculated using the following equation:



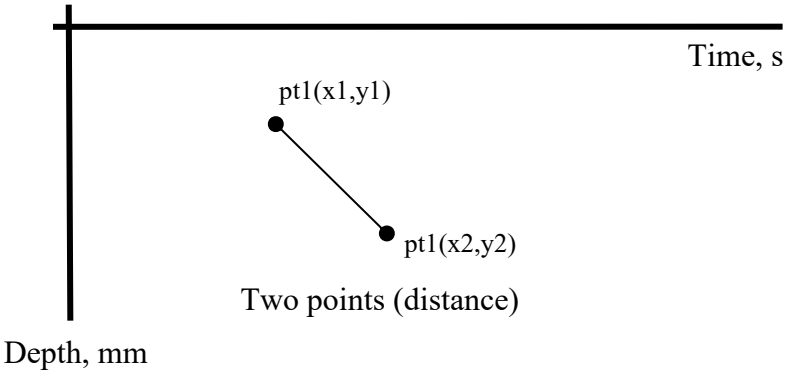
$$V = \frac{\pi \cdot dl1 \cdot ds1 \cdot ds2}{6}.$$

1.3 B Volume (1 ellipse)

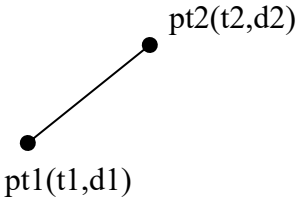
See "B Area (Ellipse)" section.

2 M mode general measurements and calculations

Usually in M mode ultrasound image horizontal axis (x-axis) represents time (in seconds), and vertical axis (y-axis) represents depth (in milimeters). On M mode image are usually performed two-point -based measurements and calculations. For measurements and calculations we use (time [s], depth [mm]) coordinate system, where each point can be described by its time (in seconds [s]) and depth (in millimeters [mm]). For example, notation pt1(x1,y1)=(5,120) means that coordinates of point pt1 are x1=5s and y1=120mm.



2.1.1 Two-points M measurements



For two-point M measurements we use coordinates (time,depth) of two end-points pt1 and pt2 of one line (distance).

2.1.1.1 M Distance

Distance between points pt1 and pt2 is calculated using the following equation:

$d = abs (d1 - d2),$

here

d [mm] - distance,
d1 [mm] - depth at point pt1,
d2 [mm] - depth at point pt2,
abs(…) means that is calculated absolute value.

2.1.1.2 M Time

Time interval (difference) between points pt1 and pt2 is calculated using the following equation:
t = abs (t1 - t2),

here

t [s] - time interval (difference),
t1 [s] - time at point pt1,
t2 [s] - time at point pt2.

2.1.1.3 M Velocity

Velocity between points pt1 and pt2 is calculated using the following equation:
Vel = abs (d2 - d1) / abs (t2 - t1),

here

Vel [mm/s] - velocity,
t1 [s] - time at point pt1,
d1 [mm] - depth at point pt1,
t2 [s] - time at point pt2,
d2 [mm] - depth at point pt2.

2.1.1.4 M Heart Rate (HR)

Heart Rate (HR) using markers pt1 and pt2 is calculated according to the following equation:
HR = 60*beats_num / abs(t2-t1),

here

HR [beats/min] - Heart Rate in beats per minute,
abs(t2-t1) [s] - time interval between markers pt1 and pt2,
beats_num [beats] - the number of heart beats (e.g., 2) in measured time interval.

3 Revision History

Revision	Revision Date	Description of Revision	Revision Author
1.0.0	2019.10.07	Initial Release	V.Perlibakas
1.0.1	2020.05.14	Changed first page photo.	V.Perlibakas
1.2.0	2020.08.11	Added information about M mode measurements.	V.Perlibakas
1.2.1	2020.08.13	Added section “M Heart Rate”.	V.Perlibakas