

ARDMS Topic: n/a

Unit 25: New Considerations

Sononerds Ultrasound Physics
Workbook & Lectures

Unit 25: New Considerations

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Unit 25: New Considerations

[Entire Unit 25 Lecture:](#)



Did you know you can time jump to each section by using the “chapters” in the YouTube video playbar OR timestamps in the video description?

Unit 25: New Considerations

When an instructor or an author builds their content, it is a fine balance of including enough information for you to understand concepts, but not sooo much that it gets to be an information overload.

My goal throughout this physics series was to use the major textbooks currently available and combine their information into a resource that prepared you well for the ARDMS Sonographic Principles and Instrumentation board exam.

Units 1-24 are solid physics concepts that will be on your SPI test, but as the field evolves, so do the technologies and therefore the exams that test your knowledge.

In this unit, I have decided to include some new technologies that may be on your exams, more bits of information that might be helpful and lastly some advice in preparing for the SPI examination.

The content presented in this last unit is subject to change, but everything, to my knowledge is current as of March 2022. I will update this lecture as major changes occur in our very exciting world of sonography.

Section 25.1 New Technologies

Ultrasound equipment manufacturers are always looking for new ways to improve ultrasound imaging and how it's used in patient care.

In unit 15a, we discussed some of those newer technologies including elastography and strain, but there are even more technologies starting to emerge.

This section is meant to be an overview of the technologies and not an indepth look as the science behind them won't be tested on the SPI, but it's good to recognize what the technologies are and what they contribute to ultrasound.

25.1.1 Fusion / Hybrid Imaging

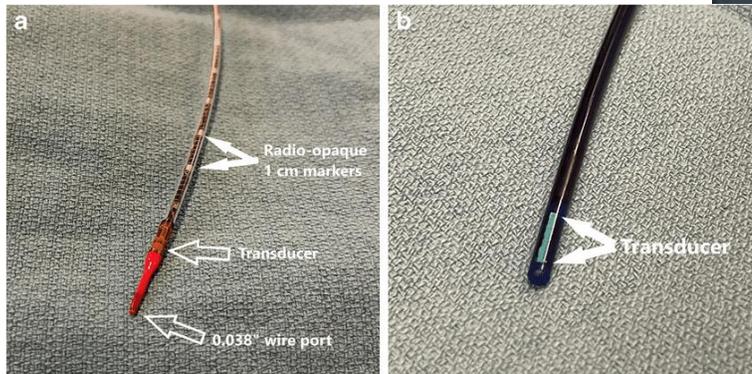
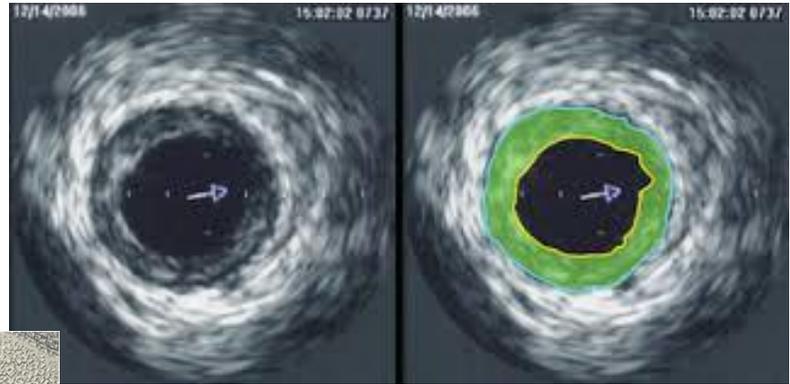
Fusion imaging allows the practitioner to simultaneously display a stored CT or MRI and a live ultrasound image. Through tracking technology, the stored CT or MRI will automatically align with where the transducer is moved on the patient.

This is useful when a lesion is better seen on CT or MRI, but ultrasound is the safer way to perform a biopsy of the lesion.



25.1.2 Intravascular Ultrasound

Intravascular imaging or IVUS uses a very small probe that can be inserted into a vessel. It gives a 360 degree view of the inside of the vessel which can be helpful for a 2D assessment for plaque or a stenosis in a vessel.

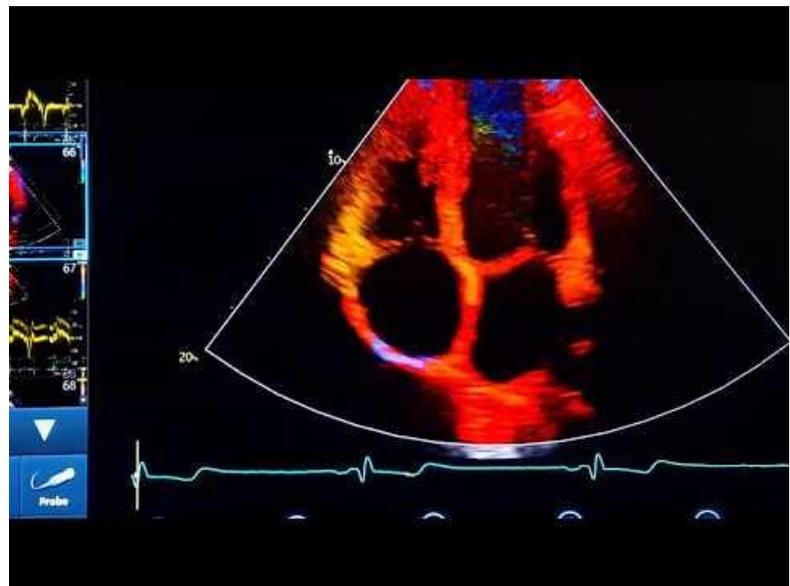


25.1.3 Tissue Doppler

Tissue Doppler Imaging (TDI) is specifically used for cardiac imaging. Just like we can use Doppler to detect motion of blood, we can use color Doppler to detect motion of the heart wall.

Typically when using color Doppler for blood, we filter out the low velocity information because we only want the information from the faster movement of blood.

With TDI, the machine uses a high pass filter, which will filter out the high velocity and leave the low velocity of the heart wall motion. Color then only appears on the walls.



25.1.4 MSK Ultrasound

Ultrasound is fast becoming an effective method to evaluate the muscles, tendons and ligaments in the body, but MRI remains the gold standard for evaluating these structures.

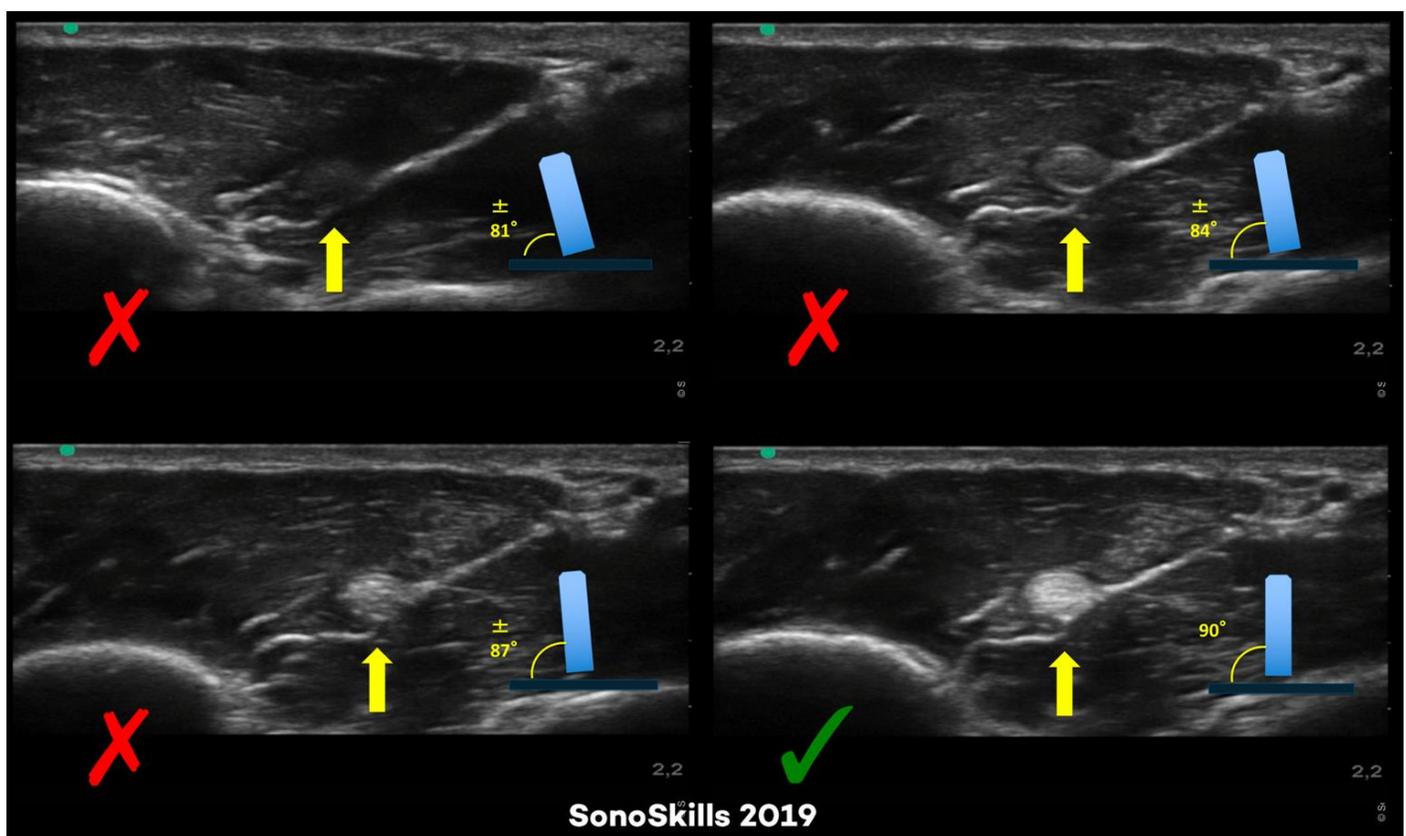
MSK ultrasound is still a very specialized exam that many sonographers are not proficient in, but more and more radiologists and sonographers are learning and expanding this subspecialty of ultrasound.

The reason MSK ultrasound brought up in this physics lecture is that there is an acoustic artifact particular to MSK.

Anisotropy is an artifact that means depending on the angle you are imaging a structure, the appearance of the returning echoes will change.

When we think about imaging the heart or the liver, no matter what angle we come at, the walls look a certain way, the chambers are anechoic, the liver has the same echo pattern to it.

Anisotropic structures look different depending if you are at the preferred 90 degrees to the structure or angled to the structure.

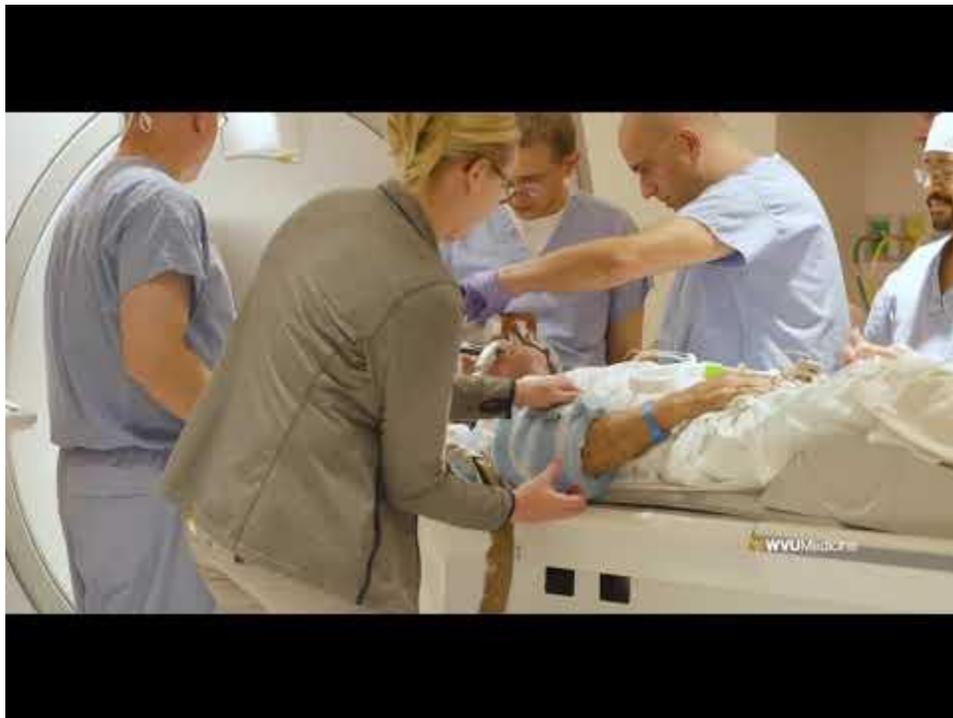


25.1.5 High Intensity Focused Ultrasound

High intensity focused ultrasound (HIFU) or Focused Ultrasound (FUS) encourages the use of ultrasound for its related bioeffects. The beam or beams of ultra powerful sound waves are focused to produce thermal and/or cavitational effects. FUS is not used for imaging.

There are multiple goals associated with FUS. It can be used to heat muscles and tissue that is therapeutic or have a cosmetic effect. It can be used to destroy unwanted tissue like cancers and other lesions or it can be used to deliver medication to a very specific part of the body.

MRI and imaging ultrasound can both be used to guide where the FUS beam is placed. It is being studied quite heavily in its effectiveness in treating neurological conditions like tremors, parkinson's, epilepsy and more. It is an effective way to have "surgery" without cutting.



Section 25.2 Basic Machine Tools

There are some basic machine tools and methodology that isn't physics based, but may be helpful to know for your exam.

25.2.1 Measurements

Images created by the machine are calibrated so that the user can measure anatomy on the screen. Calipers are typically placed on or around anatomy to indicate various pieces of information depending on the type of mode.

When placed on a B-mode image, calipers can:

- Measure how deep a structure is (cm)
- Measure the length, width or height of structure (cm)
- Measure the circumference of a structure (cm)
- Measure the area of structure (cm²)
- Measure the volume of a structure (cm³)

When placed on a spectral tracing, calipers can:

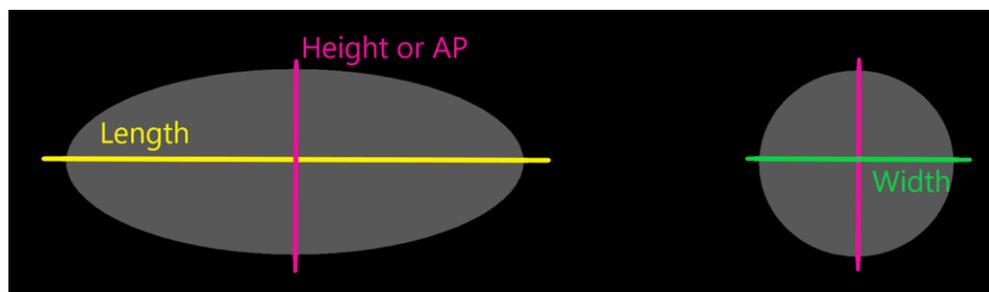
- Measure velocities (cm/s or m/s)
- Measure Resistive Index
- Measure Acceleration time (ms)

When placed on an M-mode image, calipers can:

- Measure distance of motion (cm)
- Measure length, width or height (cm)
- Heart rate (bpm)

When measuring on a B-mode image:

- Length is seen at the longest axis of the organ.
- Height or Anterior Posterior images are measured perpendicular to the length or to the width.
- Width measurement is taken at the shortest axis of the organ. This is usually a turn of 90 degrees from the long axis



25.2.2 Cine Clips

Cine is a feature on modern ultrasound machines where the machine will store a bunch of images. You can then “cine” back and look at the frames. You can also save the cine as a “cine clip.” **Cine is a post-processing function.**

The cine feature is helpful when there are moving structures and you saw what you needed right before freezing OR you want to show the motion of those structures.

Cine clips are commonly used in echocardiography in lieu of taking still images. It is more diagnostic to show the cardiologist the motion of the heart than a still picture of it.

Cine clips are used often in general ultrasound as well, to show what “live” scanning of pathology may look like and help the radiologist make a better diagnosis. Be careful of taking too many clips though, there are over 100 images in each clip and take up a lot of space.

Cine clips can be set as **retrospective**, capturing the clip up until the image was frozen. For example, the last 3 seconds of live imaging. OR they can be set up to **prospective**, in which they will capture the next frames generated. For example the next 3 seconds of live imaging.



25.2.3 Sweep Speed

As the M-Mode window and Doppler window refresh, time goes by at a certain speed. This is called the sweep speed. You can change how fast or slow the machine displays information in the window by changing the sweep speed.



Section 25.3 Waveform “Anatomy”

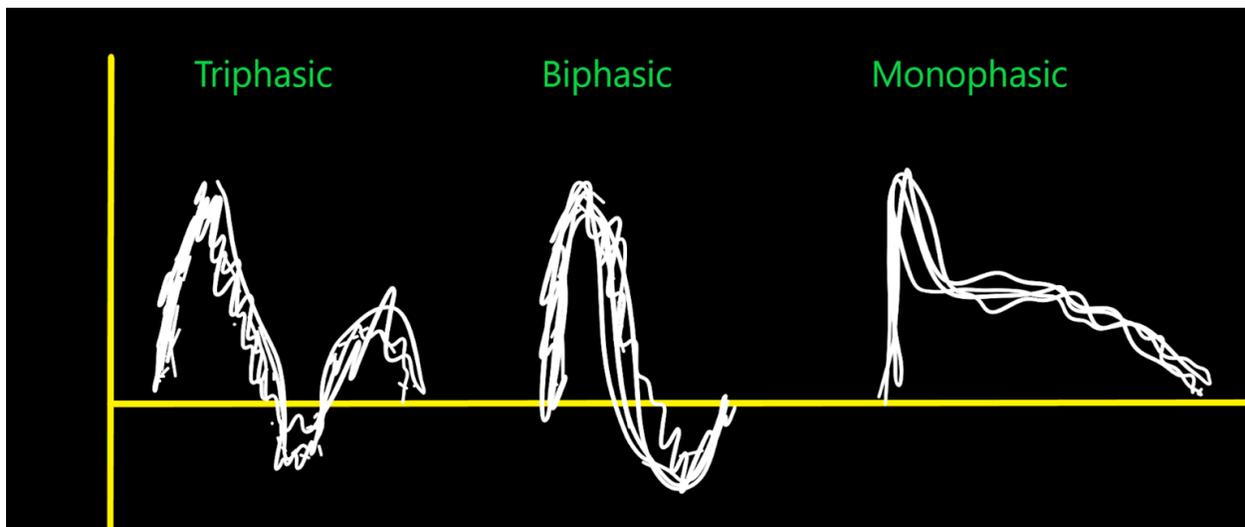
Some of these terms were discussed in the Doppler section, but they are not necessary to understanding Doppler physics. Doppler physics is going to focus on just that. You shouldn't have questions about the waveform anatomy as this is more specific to vascular and echocardiography, but they are often used when discussing the Doppler because parts of the spectral waveform do have names and patterns that we recognize.

25.3.1 Arterial Waveforms

Triphasic Waveform – A waveform with above, below & above baseline components

Bi Phasic Waveform – A waveform with above and below baseline components

Monophasic Waveform – A waveform with only above the baseline component



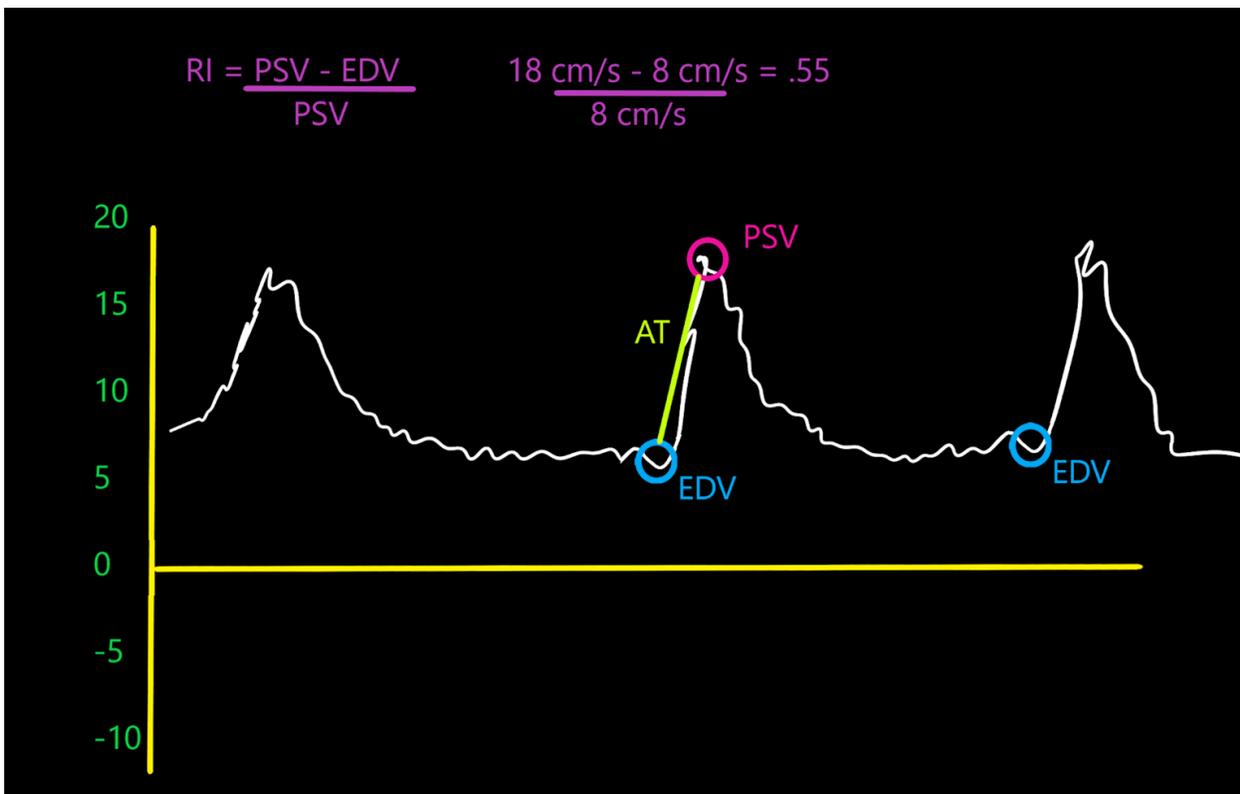
25.3.2 Parts of the Spectral Tracing

Peak Systolic Velocity - Highest recorded velocity of a waveform

End Diastolic Velocity - Velocity of blood right before the onset of systole

Acceleration Time - Time it takes from the EDV to get to the PSV. Typically less than 0.08 seconds. Long acceleration times are abnormal.

Resistive Index - Describes the vascular bed the blood is going to. Calculated by: $PSV - EDV / PSV$. Low resistive waveforms are usually monophasic, like those going to the brain or liver. These organs ALWAYS need blood. High resistive waveforms are biphasic and triphasic and often seen going to the limbs.



Section 25.4 Preparing for the SPI

You should double check with your school or institution for any site specific guidelines for the SPI. You should also contact the ARDMS if you have any questions about how to apply or what prerequisite to use.

25.4.1 Review Material

As a disclaimer, I am not associated with any of these businesses. These are my opinions and feedback that I have heard over the years. Everyone learns differently and has different needs as they prepare for the test.

A lot of students find it helpful to study from review material. In particular, review material that goes over questions. There are multiple ways to access review material you can perform an internet search to learn more. However, some of the more popular resources include:

- YouTube
- Quizlet
- [Davies Publishing](#)
- [ESP X-Zone](#)
- [Ultrasound Registry Review \(URR\)](#)
- [ARDMS](#) (under prepare)

No matter what study material you use keep this one rule in mind...

RECOGNITION IS NOT RECALL.

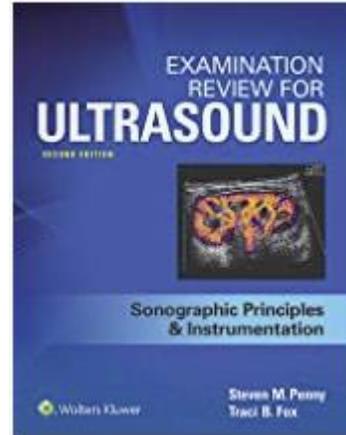
Many students get comfortable with thinking they understand or can recall a topic, but when in reality they only recognize the question and what the right answer is. Or recognize the block of text they're reading. Use the mock exams as a way to assess where your studying is deficient so you can brush up on the areas that need it and skip the areas you have mastered.

Try teaching someone else a topic or write about the topic in your own words to see if you truly recall the material or are just remembering the answer to a particular question.

Review seminars are also of value to some students. Some of the seminars include:

- [URR](#)
- [Traci Fox](#)
- [ESP / Dr. Edelman](#)
- [My Ultrasound Tutor](#)
- [Exam Refresh](#)
- And of course...me! 😊

Review books such as the [Penny/ Fox book](#) have high remarks as well. (link to Amazon).



25.4.2 SPI Content

If you navigate to the ARDMS website, you can read all about the SPI.

[ARDMS - SPI](#)

But my favorite resource on this page is the detailed SPI outline:

[SPI OUTLINE](#)

The SPI outline will tell you exactly what to expect from the test, what topics could be covered and what percentage each topic will hold.

The whole test is 2 hours long and will have about 110 multiple choice questions. A calculator is not necessary for the test, but a basic one may be provided by your testing site.

25.4.3 Taking the SPI

You need to sign up for an ARDMS number if you don't have one and then register to take the test. You will provide documentation that shows you are eligible to sit for the SPI. Currently, it costs \$225 for the exam.

Testing is either done at testing center or at your home. Home testing rules and requirements are very strict. You should review the rules and requirements before choosing this option.

A score of 555 out of 700 is required to pass the SPI.

Once you have passed the SPI, you have 5 years to sit for a specialty exam to complete your registry. You only have to take the SPI once. You do not need it for subsequent specialities unless you fail to get registered in the the 5 year window.

My last bit of advice is to take the test sooner than later. If you are currently in school and have a semester break coming up. Try to schedule your test for that time. You most likely just had to study for a physics final and you should use that study time towards passing your SPI. Many students regret not taking it as soon as they were done with class as this is all pretty easy stuff to forget.

BUT don't go into the test expecting to pass. You do need to have a strong mastery of the topics and some people get that from scanning and learning more hands on. This is where a good mock test will tell you your preparedness and help you to determine when you're ready.

I wish you nothing but GOOD LUCK in all of your ultrasound adventures. I hope your hard work and tenacity pays off. Thank you for coming along on this journey with me - now go own that physics test, so we can celebrate!

Section 25.5 Nerd Check!

1. What is fusion/hybrid imaging?
2. What is IVUS?
3. What is tissue Doppler and how does it work?
4. What is anisotropy?
5. What are some of the goals of HIFU or FUS?
6. What can be measured on a B-mode image?
7. What can be measured on a spectral tracing?
8. What can be measured on an M-mode image?
9. Describe length, height and width measurements.
10. What is a cine?
11. When are cines processed?
12. What is a retrospective cine and prospective cine?
13. What does sweep speed do?
14. Describe a tri-, bi-, and mono-phasic waveform.
15. What is the peak systolic velocity?
16. What is the end diastolic velocity?
17. What is acceleration time?
18. What is resistive index and what does it tell us?