Instituto Tecnológico y de Estudios Superiores de Monterrey

Procesamiento de imágenes médicas para el diagnóstico (Gpo 300)

MRI 2nd Activity

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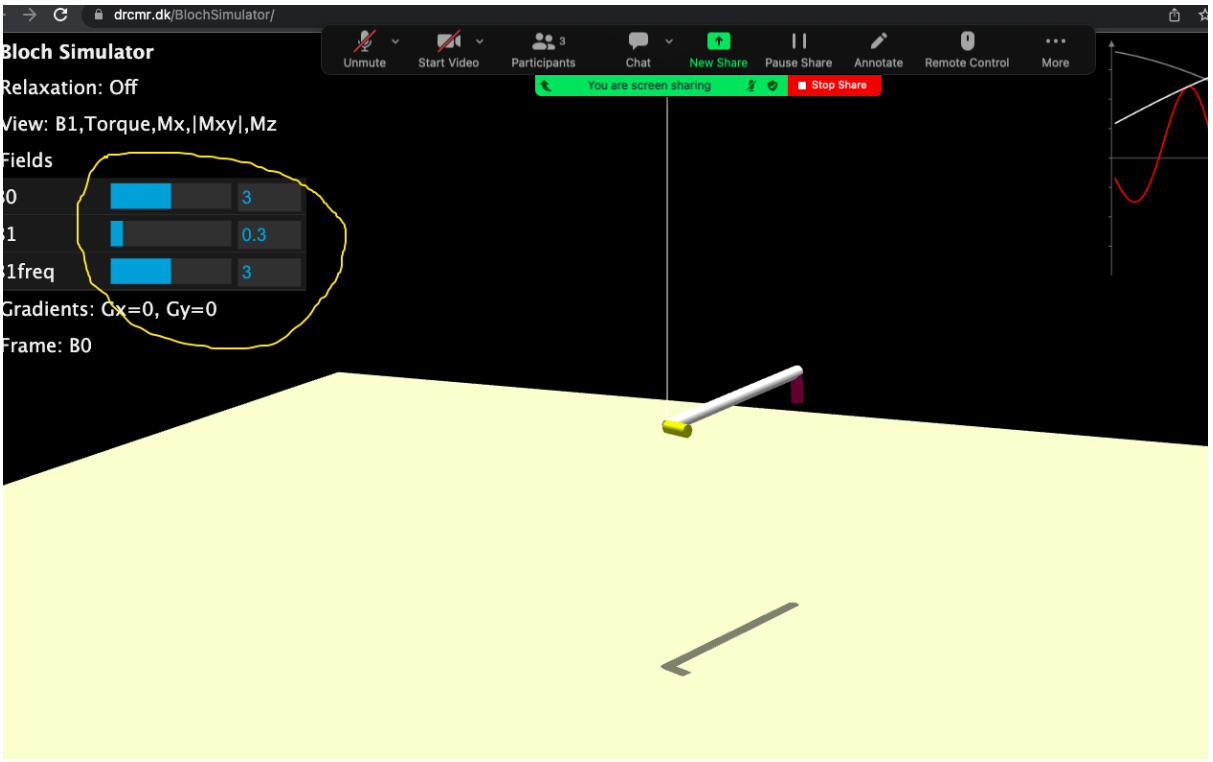
RF effect.
Open the simulator: https://www.drcmr.dk/BlochSimulator/

1. You start by looking at the magnetization of a sample represented with a gray bar. To begin with the activity, be sure the specifications are as follows:

- Mode: Equilibrium
- Relaxation: off
- B0: 2
- B1: 0
- B1freq: not relevant at this point (it can
- have any value)
- Gradients: both 0
- Frame: Stationary.

2. You are going to look at the effect of applying an RF (B1 field).
3. Click on View and be sure all the options are activated
4. Click on Field and be sure B0 is on 3T, let B1freq in any value. Then put B1 in 0.3 and look at the effect on the magnetization (grey bar).
5. You can see the magnetization precessing arbitrarily.
6. To see more clearly the effect you should change the frame of reference. Observe how much and in which manner the magnetization moved away from the original direction.
7. Click on Frame and choose the frame of reference of the field B0.

The effect is not too strong because the frequency of B1 is not the resonant frequency. **Change the value of B1freq until the torque points towards only one direction. Once you find the appropriate frequency register it for your report**



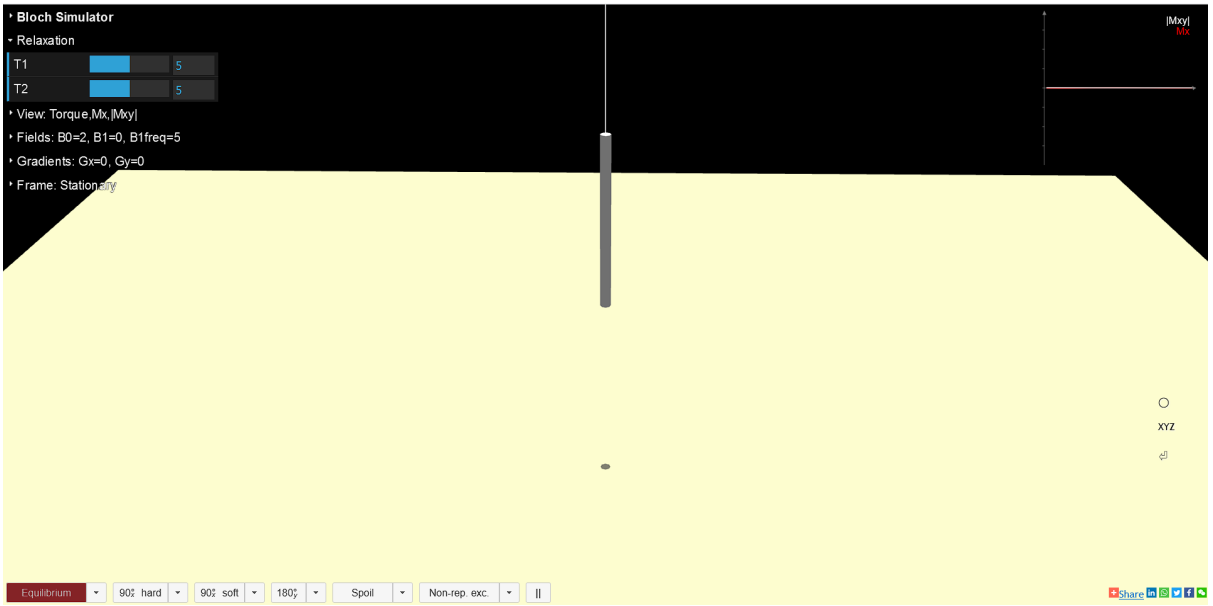
El valor funcional es de B1freq = 3 ya que hace que solamente rote el torque. Es decir el eje gris al rededor del eje amarillo.

8. Change between B0 and stationary frames of reference to observe by yourself and understand how the complete phenomenon is happening.
9. Once you have a strong signal (the length of the shadow in large) turn off B1.

Relaxation times

Until now, you explored the effect that the transversal field has on the magnetization. Now you should return it to the equilibrium. For doing so, you need to change the relaxation times.

1. First look at the effect of the T2 relaxation time.
2. Click on Relaxation and change T2 to 5 seconds.
3. Observe how the transversal magnetization decays
4. Now change T1 to 5 seconds.
5. Observe how it returns to the equilibrium state.



Complete process

Now repeat the entire process by yourself using different relaxation times combinations.

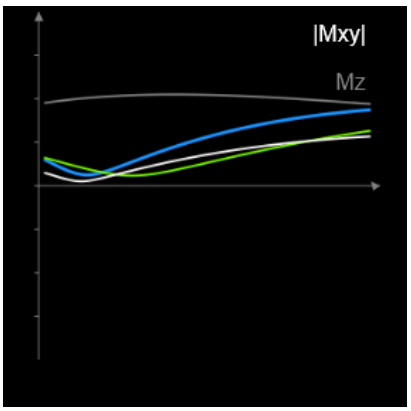
1) Start in the equilibrium.
2) Turn on B1.
3) Set the resonant frequency.
4) When you obtain a strong signal, turn off B1.
5) Use different relaxation times and observe the effect when changing the frames of reference from Stationary to B0 and again to Stationary as many times as you need to understand the process (at least once).

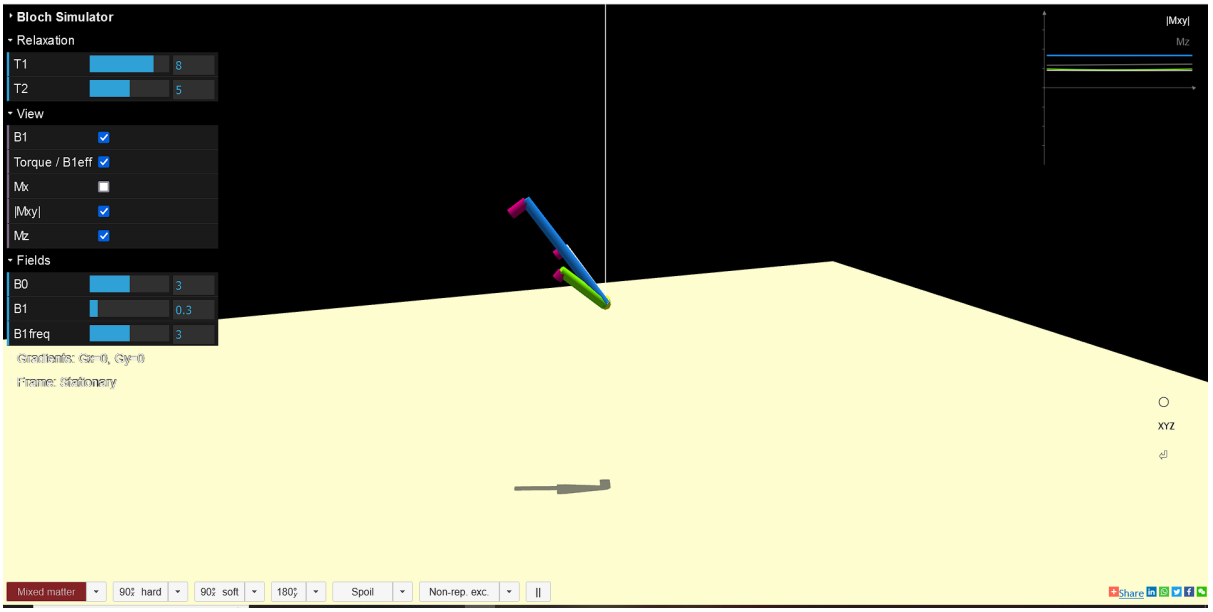
Remember to take ss during convenient times for your report.

Different tissues

Change the mode to Mixed matter. You are going to see the magnetizations corresponding to samples of different tissues with different colors. At the beginning all of them are together so you can't differentiate them.

Now repeat the process that you previously learned and observe how the magnetizations of the different tissues respond differently (**Take evidence with ss**). **Explain in your report the differences (signal's strength and time) between the magnetizations referring to them by colors.**



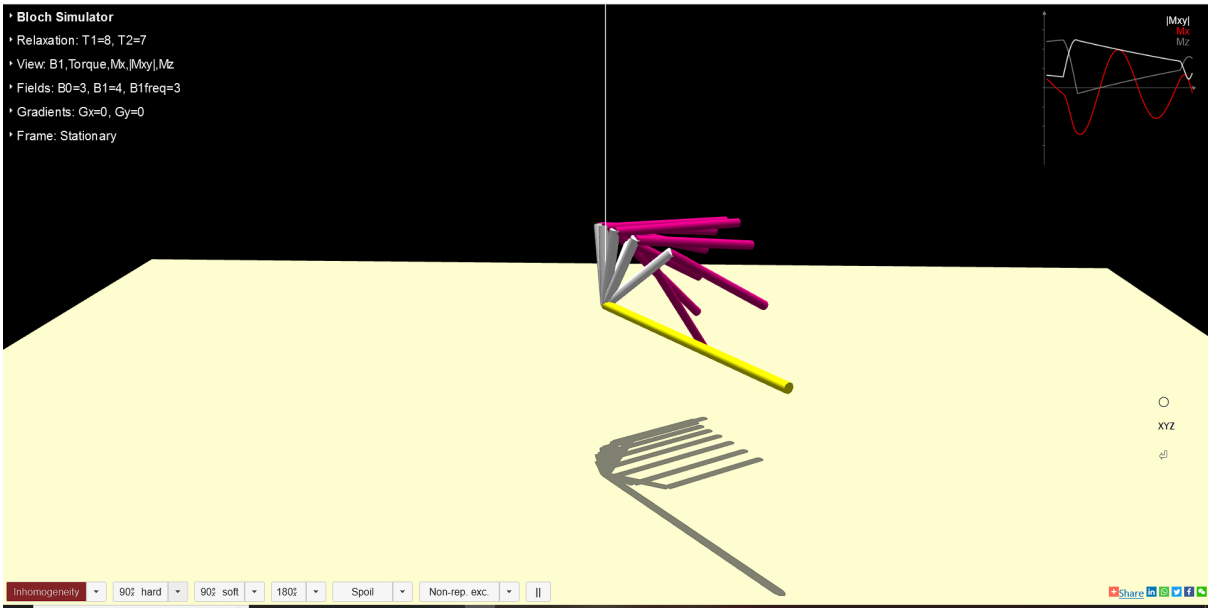


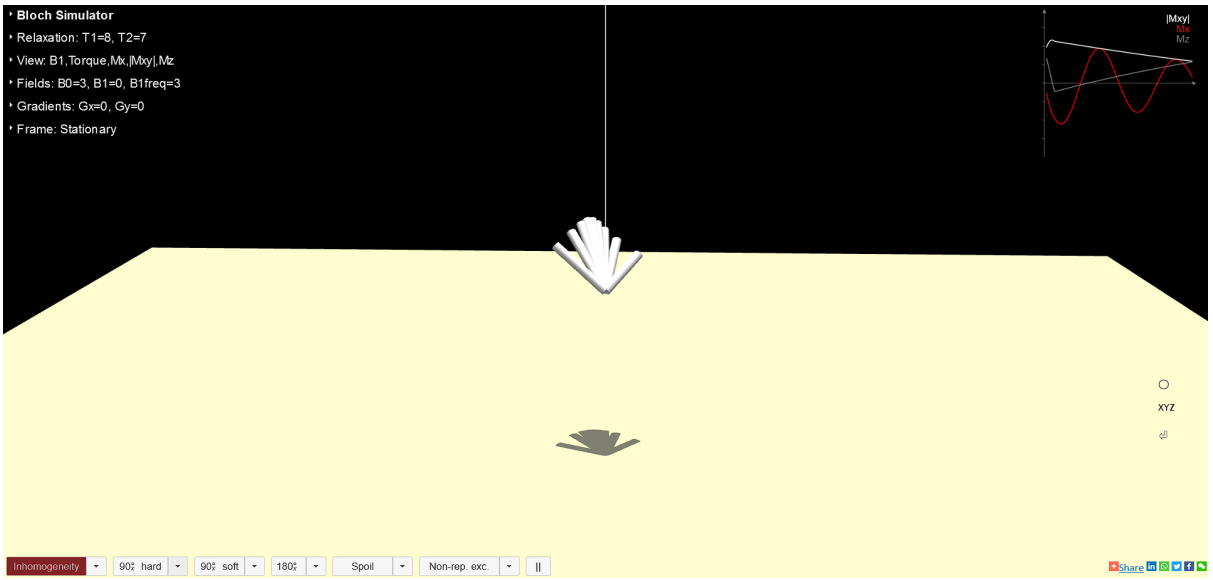
En primera instancia cuando se cambian los valores de los campos se puede observar como están intentando llegar a un balance de las 3 magnetizaciones. Después de unos segundos estas llegan a cierto nivel de equilibrio a través del tiempo en donde tienen diferentes valores del torque. En este caso se desconoce el valor exacto de este, sin embargo, en orden ascendente por colores quedaría: verde, blanco y azul, siendo el verde el de menor valor. Cuando se cambia el valor de B0 la inclinación de las magnetizaciones cambia, en el caso de B0=3 se tiene una inclinación diagonal mientras que en otros valores se asemeja más a una línea vertical.

Spin echo

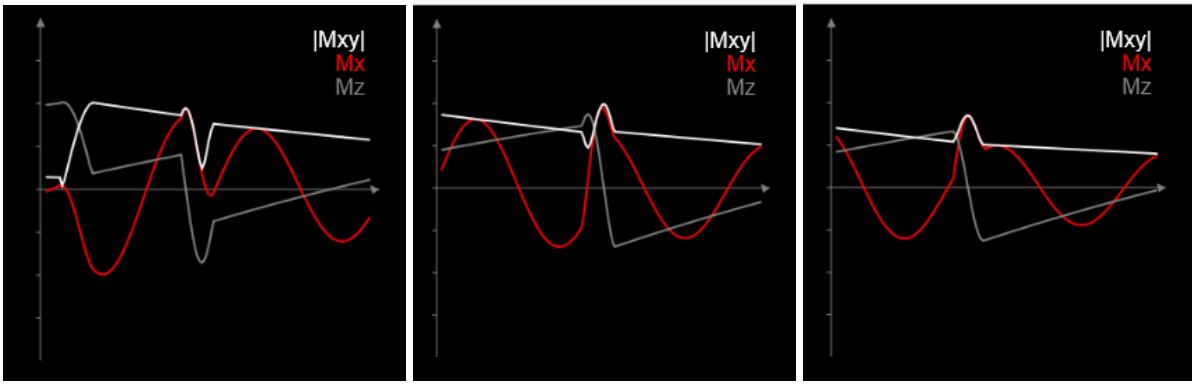
Now you are going to explore spin-echo and with it the dephasing effect.

1. Start with the specifications of the image. Note that Inhomogeneity mode was chosen. The commands in the bottom allow you to apply a quick pulse of 90° in the x-direction and 180° in the y-direction.
2. Apply a 90°x hard pulse.
3. As the sample is not homogeneous you can see how the magnetizations are dephasing. **Take an ss of this effect.**

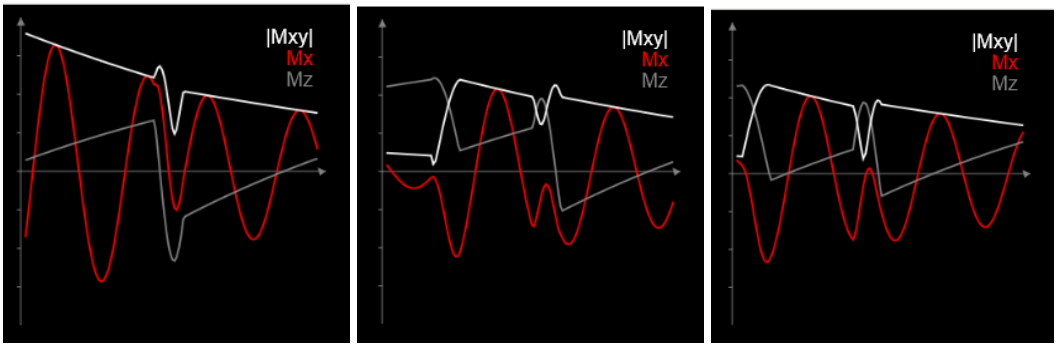




4. After the magnetizations are dephased and they start to return to the equilibrium state apply a 180°y pulse.
5. Note how you obtain an echo with this process. If you do it at the correct timing the echo is going to be strong. **Try to obtain your best result and take an ss of the graph**. Play with different specifications (B0, T1, T2, etc.).



B0 = 3, T1 / T2 = 8



B0 = 5, T1 / T2 = 5