

Simulation of Respiratory Mechanics



Department of Electronic and Telecommunication

University of Moratuwa

BM-2101 – Modelling and Analysis of Physiological Systems

T.L Abeygunathilaka – 200003P

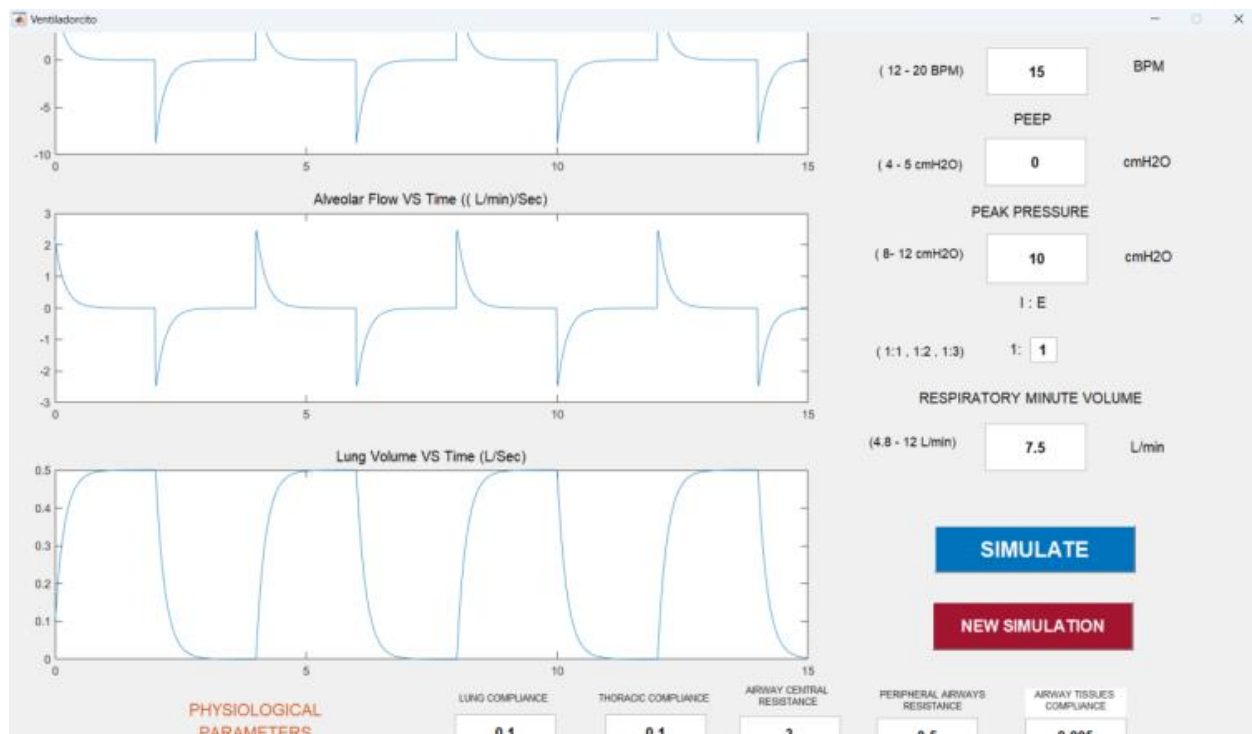
1. Normal person

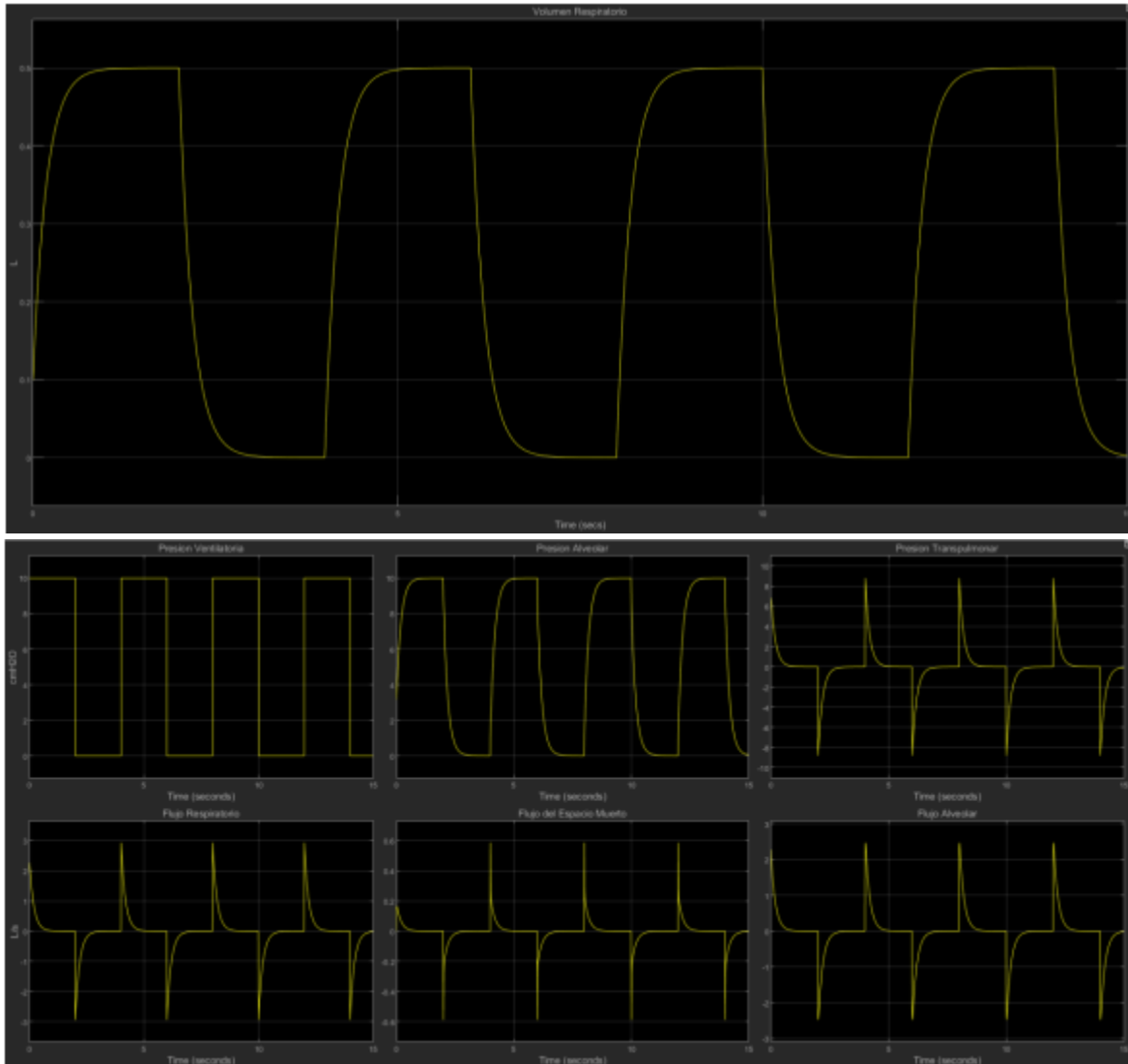
Respiratory values for a normal person under normal conditions

- Lung compliance – 0.1 L/cmH₂O
- Thoracic compliance - 0.1 L/cmH₂O
- Airway central resistance - 3 cmH₂O/(L/s)
- Peripheral airway resistance – 0.5 cmH₂O/(L/s)
- Airway tissue compliance – 0.005 L/cmH₂O

Parameter values for a normal person who has connected to a ventilator.

- Breathing frequency – 15
- PEEP – 0
- Peak pressure – 10





2. Restrictive pulmonary disease

Restrictive pulmonary disease is a group of lung disorders characterized by decreased lung expansion, resulting in reduced lung capacity and impaired breathing.

Lung compliance decreases, making it harder for the lungs to expand and contract effectively. Thoracic compliance is reduced, leading to stiffness in the chest wall and limited chest expansion during breathing.

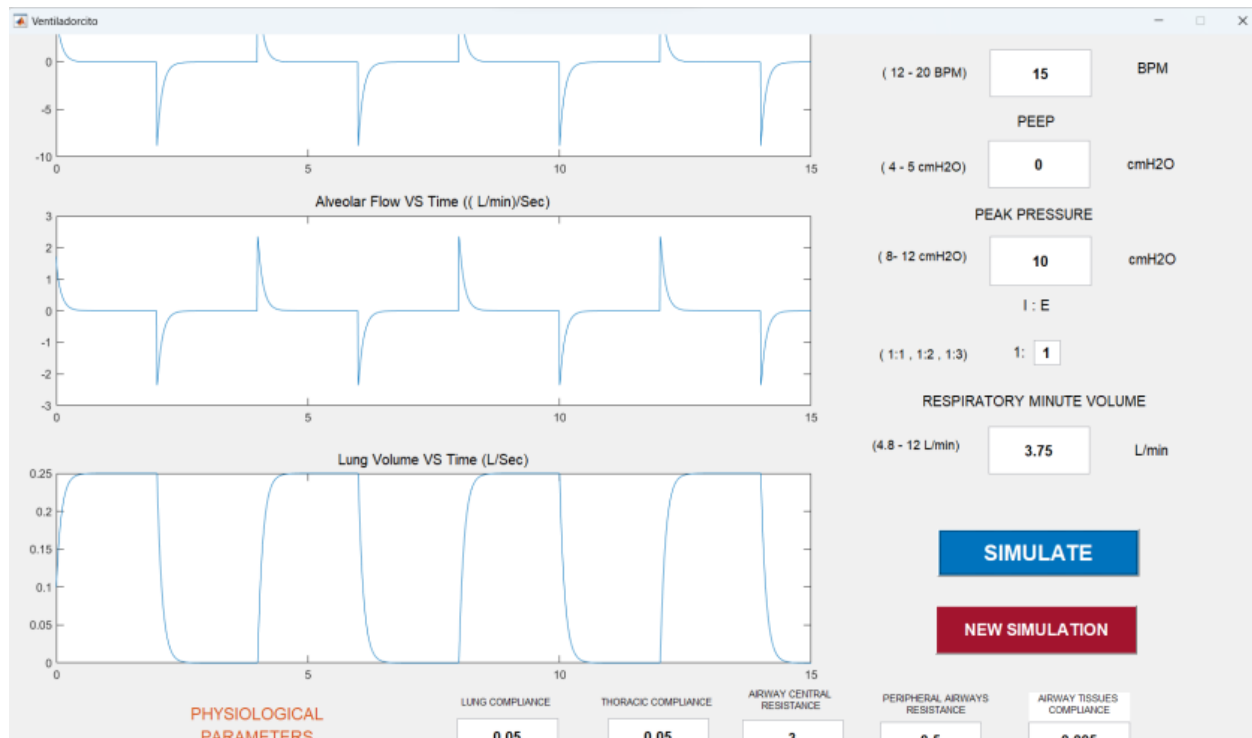
Respiratory values for a person under normal restrictive pulmonary disease.

- Lung compliance – 0.05 L/cmH₂O
- Thoracic compliance - 0.05 L/cmH₂O

- Airway central resistance - 3 cmH₂O/(L/s)
- Peripheral airway resistance – 0.5 cmH₂O/(L/s)
- Airway tissue compliance – 0.005 L/cmH₂O

Parameter values for the person who has connected to a ventilator.

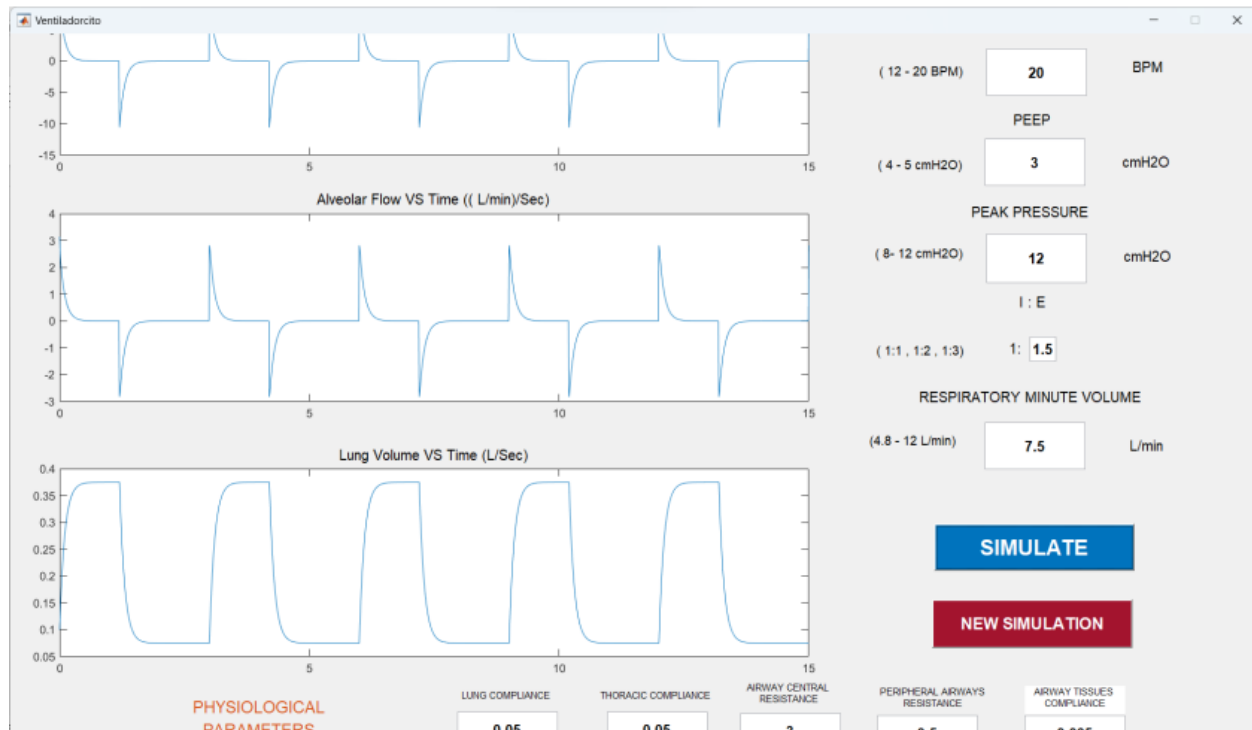
- Breathing frequency – 15
- PEEP – 0
- Peak pressure – 10



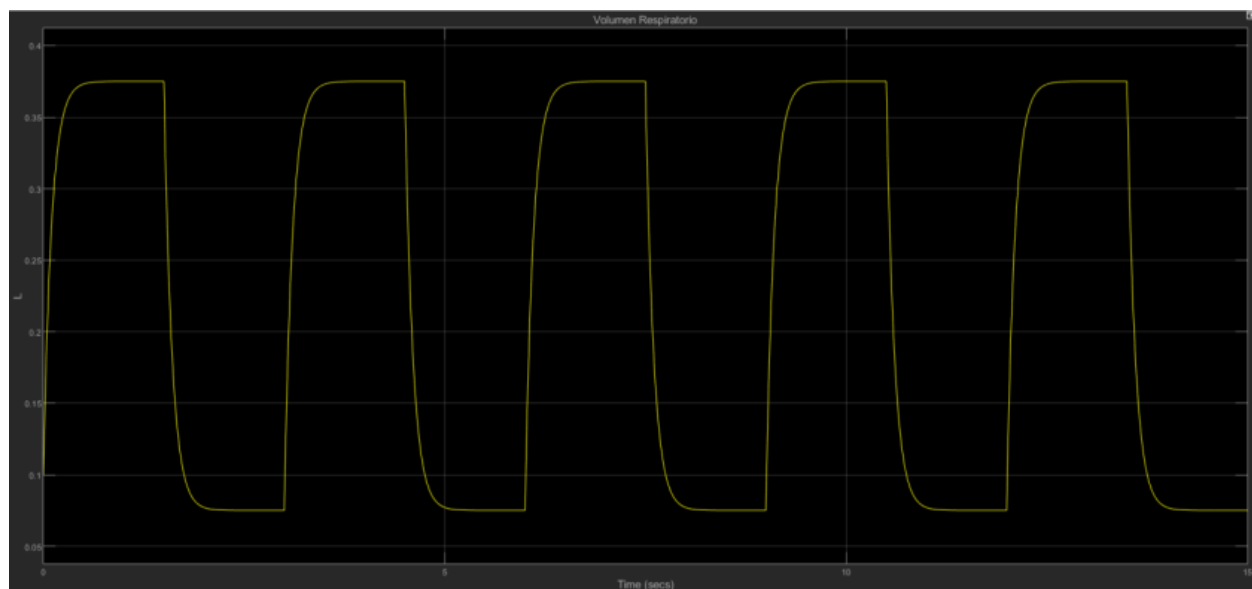
Respiratory minute volume has reduced.

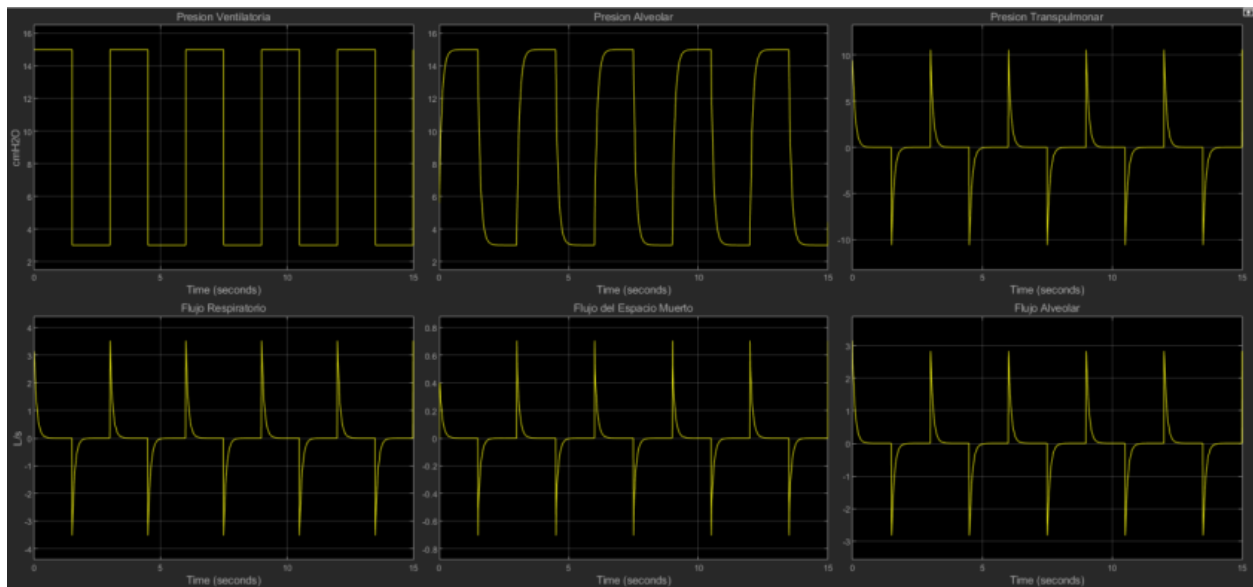
Therefore, ventilator settings have to be adjusted accordingly such that;

- Breathing frequency – 20
- PEEP – 3
- Peak pressure – 12
- I:E ratio – 1:1.5



with new setting





3. Obstructive pulmonary disease

Obstructive pulmonary disease refers to a group of chronic lung conditions characterized by narrowed airways, increased airway resistance, and difficulty exhaling. In this condition, lung compliance may be relatively normal, but tidal volume, the amount of air moved in and out of the lungs during each breath, is often reduced due to the increased resistance in the airways. As a result, the affected individuals may have trouble exhaling fully, leading to trapped air in the lungs, hyperinflation, and decreased expiratory flow rates. Common examples of obstructive pulmonary diseases include asthma and chronic obstructive pulmonary disease (COPD).

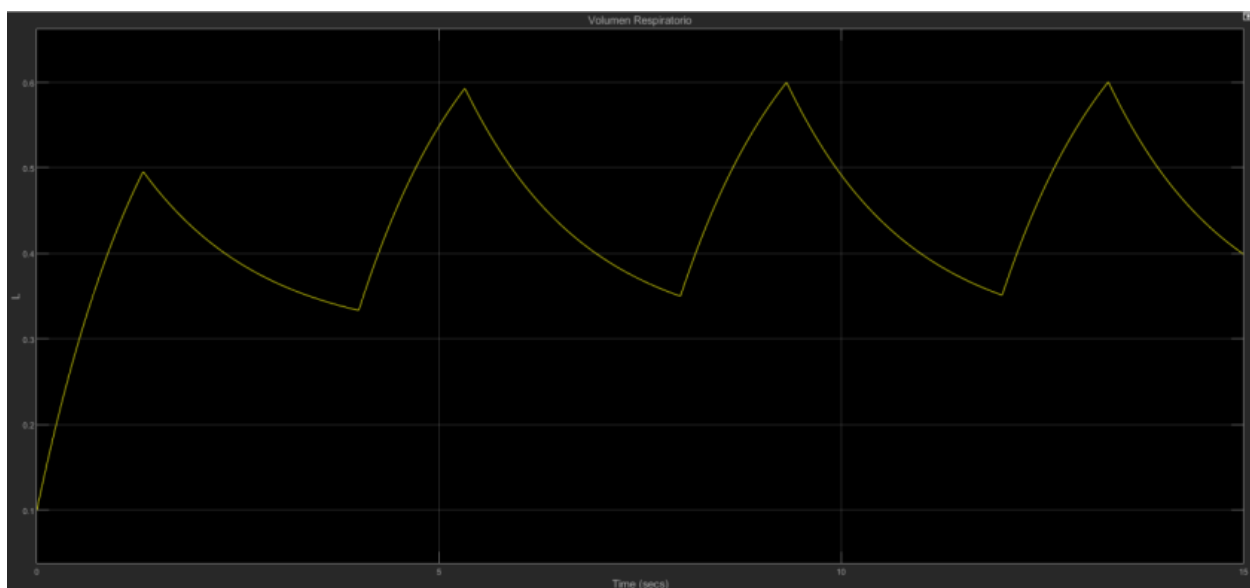
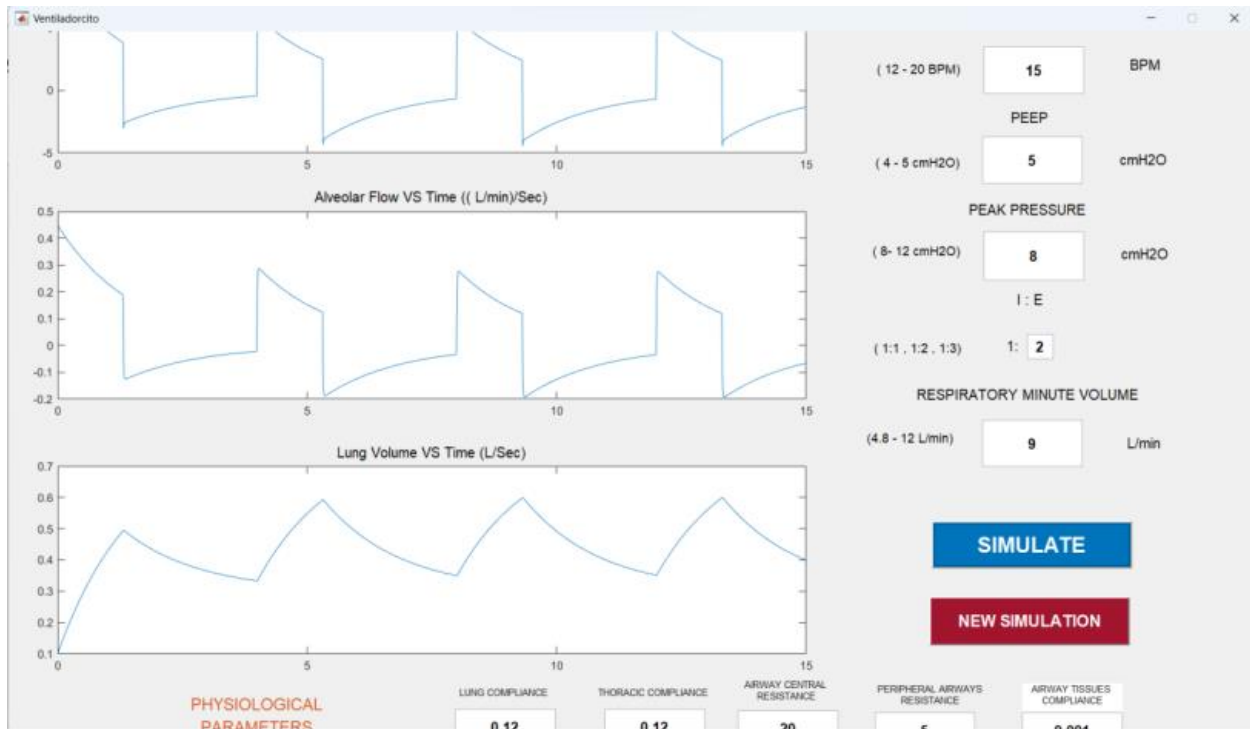
Values for obstructive pulmonary disease.

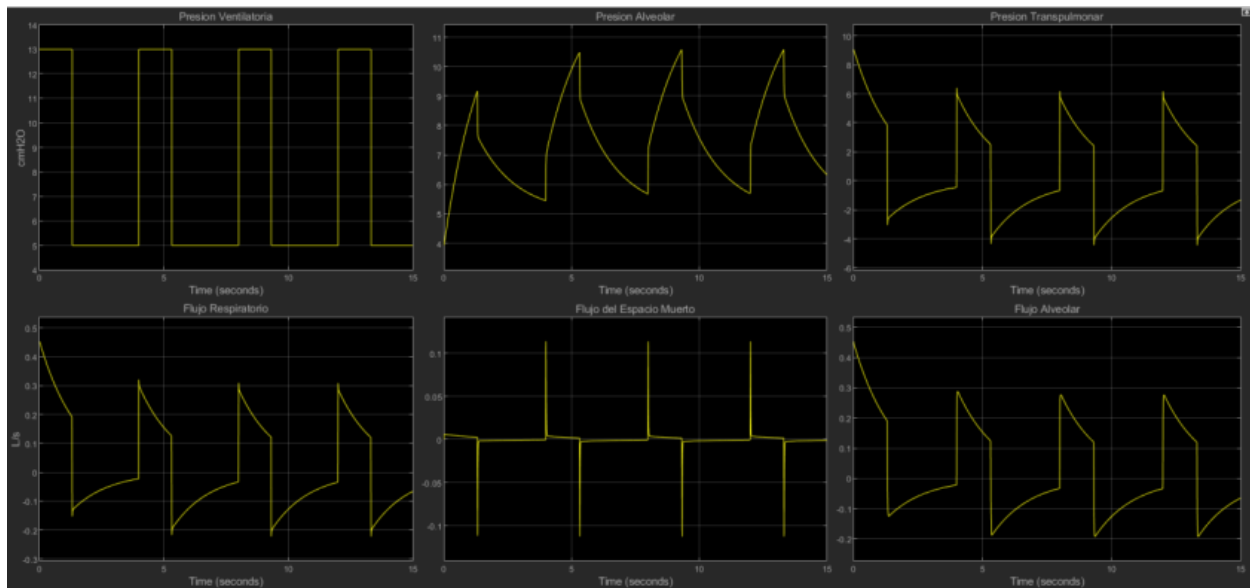
- Lung compliance – 0.12 L/cmH₂O
- Thoracic compliance - 0.12 L/cmH₂O
- Airway central resistance - 20 cmH₂O/(L/s)
- Peripheral airway resistance – 5 cmH₂O/(L/s)
- Airway tissue compliance – 0.001 L/cmH₂O

Ventilator settings have to be changed accordingly.

- Breathing frequency – 15
- PEEP – 5
- Peak pressure – 8
- I:E ratio – 1:2

Results are as follows





Differences in minute ventilation for the same setting of the ventilator

Minute ventilation (MV) = respiratory rate (RR) X tidal volume (TV)

It depends on different reasons.

- Patient's underlying condition
- Patient size
- Ventilator settings
- Patient's effort

If MV is lower the patient may lack enough oxygen. And if MV is higher it can cause lung injuries.

