MODELS FOR THE RESPIRATORY SYSTEM

The respiratory system is a fractional order system
- is a dynamical system whose model can be represented in a natural way by non-integer order parameters
- acknowledges some specific phenomena:
  - \text{fractal structure} \rightarrow \text{the AIRWAY GEOMETRY has a fractal structure}
  - \text{diffusion} \rightarrow \text{in the alveoli GAS EXCHANGE by means of diffusion takes place}
  - \text{viscoelasticity} \rightarrow \text{the LUNG PARENCHYMA is viscoelastic}

\text{a fractal mechanical model for the respiratory system}

The clinicians prefer a simple, yet accurate model from whose parameter values they are able to detect whether a patient has a lung pathology or not. It is therefore interesting to characterize the lung function in terms of its mechanical properties as stress, strain and viscoelasticity, which can be directly related to changes in airway duct geometry.

The airways are investigated within the 

<table>
<thead>
<tr>
<th>Level</th>
<th>Length</th>
<th>Radius</th>
<th>Wall thickness</th>
<th>Cartilage fraction $\kappa$</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>0.50</td>
<td>0.10</td>
<td>0.010</td>
<td>0.50</td>
</tr>
<tr>
<td>21</td>
<td>0.10</td>
<td>0.090</td>
<td>0.006</td>
<td>0.000</td>
</tr>
<tr>
<td>22</td>
<td>0.070</td>
<td>0.060</td>
<td>0.015</td>
<td>0.000</td>
</tr>
<tr>
<td>23</td>
<td>0.055</td>
<td>0.030</td>
<td>0.047</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The obtained results
- qualitatively:
  - similar as in literature [2, 4]
- quantitatively:
  - not possible to evaluate

**CONCLUSIONS**

A mechanical equivalent is derived, based on an electrical symmetrical model.
- the elements are calculated with morphological values
- the model provides the means to investigate fractional behavior
- the stress-strain properties are evaluated at every level, but interrelated with the consequent levels within the network.

Following steps:
- asymmetric tree
- other similarly branching systems

**REFERENCES**