

## Z. Topor

### Cardiovascular-Respiratory System Modeling and Applications

#### The topics covered are as follows:

1. The first topic will be dedicated to a historical review of most important models of the respiratory control system. For each model one characteristic feature will be emphasized to illustrate a gradual progress in our understanding of the respiratory control and translation of this knowledge into the computational realm
2. Development of a modern, Grodins' type model of the respiratory control system will be presented. Special attention will be given to plant description and derivation of controller's equations from a steady state experimental data.
3. In the third unit I will present a typical approach to model validation including selection of experimental data against which model's predictions will be tested and some aspects of sensitivity analysis.
4. System identification technique will be introduced as an alternative to the descriptive modeling based on time-delayed differential equations. I will demonstrate how one technique can benefit the other by providing necessary insights and assessing possible changes introduced into the system by pathology.
5. This unit will be dedicated to the stability analysis of the respiratory control system during sleep. I will introduce a concept of the chemosensitivity plane as an intuitive graphical method used to elucidate complex interaction between central and peripheral chemoreflex loops.
6. Model based analysis of sleep disordered breathing in congestive heart failure will be presented. I will demonstrate how the model and other introduced earlier techniques may be used to explain the mechanism of central sleep apnea in patients with congestive heart failure.
7. As a final topic I will discuss how expansion and refinement of the introduced earlier concept of the chemosensitivity plane may lead to the development of a new clinical treatment for central sleep apnea based on transient intervention.