Modeling in time series: an integrated approach

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ABSTRACT

This study is directed towards integrating stochastic and physiological models for analyzing blood pressure recordings of rats and humans. The ultimate goal is to better understand the mechanisms that determine and control blood pressure and to use this knowledge to study the genetic basis of hypertension. Stochastic models that describe long-term memory processes are extensively studied and applied to characterize blood pressure recordings of rats with denervated baroreceptor reflex and such with baroreceptor intact. Dynamical system approach is also applied to characterize the data. Lyaponov exponents and Correlation dimension are two of the main characteristics of chaotic behavior that are used. The method is applied to human populations of African Americans and French Canadians. Both stochastic and dynamical system approaches are used in distinguishing between different groups of rats and patients.

Going to the physiological side, models that capture the main physiological mechanisms involved in blood pressure regulation are considered. Theoretical and numerical analysis are performed, including bifurcation and simulation study.

This work enables us to integrate stochastic, dynamical system and physiological models to achieve a detailed and significant quantification of blood pressure recordings. The results of the physiological characterization are later used in genetic and linkage analysis that give more insight into the genetic basis of hypertension.

REFERENCES

[1] Tonellato, P., Kendziorski C.M., Cowley, A.W., Jr., Characterization of blood pressure dynamics of the rat: a model based approach, The Americal Physiological Society, February, 2000