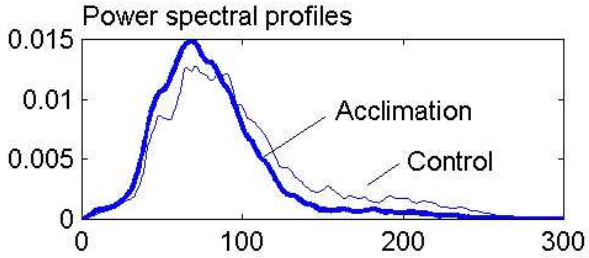
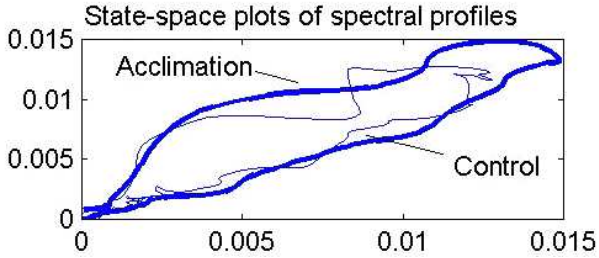
ASSESSMENT OF HEAT-ACCLIMATION STATE IN RATS THROUGH THE SPECTRAL ANALYSIS OF THE EKG SIGNAL

P.P. Kanjilal, C.B. Matthew and R.R. Gonzalez, U.S. Army Research Institute of Environmental Medicine, Natick, MA 01760, USA.

The heart rate variability (HRV) has been widely used to assess the cardiac condition as well as the physiological state of humans and animals. In these studies, usually the HRV series or the R-R interval (RRI) series derived from the EKG signal are analyzed using spectral decomposition methods. In the present work, EKG signal has been analyzed to assess the state of heat acclimation in rats. *Materials and methods:* Adult, male Sprague-Dawley rats were divided into control (C) and heat acclimation (HA) groups (male, N=6 per group). Telemetry transmitters were surgically implanted into rats (sodium pentobarbital 50 mg/kg, i.p., supplemented, as required, with methoxyflurane to maintain anesthesia) 2 weeks prior to starting data collection. Initially, both the groups were housed at 26°C, 50% rh. HA, unrestrained rats were subsequently housed at 32-33°C, for 2 weeks. ECG signals (sampled at 1000Hz, 10 sec strips every 10 min for 1 hour) were collected at the same time of day 3 days a week prior to and throughout the 2 weeks of acclimation. Power spectral density of unit time-differenced EKG series were computed using Welsch's method. To compute the average energy pattern for the HA rats, singular value decomposition (SVD) was used (see: Kanjilal, 1995). The individual profiles were arranged into the rows of a matrix, which was SV-decomposed; the average energy pattern was estimated from the first column of the right singular vector matrix. *Results:* Spectral profiles for the rats showed significantly smoother profiles following HA compared to the same for the C rats. The average energy pattern for the HA population (computed from the EKG obtained on the sixth recorded day) and the same for a C rat over six days are shown in the Figure. The HA and the C states are conspicuously different in the state-space plot for the estimated spectral pattern series $\{x(k)\}$ against $x\{(k+9)\}$. The state-space plots of the spectral profiles for the individual rats are observed to be a direct means of qualitative assessment of the HA state of the animals. The comparative analysis using Mann-Whitney rank sum statistic (MWRS) between profiles for the successive days shows that subsequent to acclimation, the MWRS usually drops to <1, whereas it remains >1 and usually >1.96 for the C group. Our findings provide evidence that sympathetic drive, during the heat acclimated state, becomes reduced possibly affecting cardiac contractility. These findings have important clinical implications in controlling cardiovascular risk factors.





Kanjilal, P.P., 1995. Adaptive Prediction and Predictive Control. IEE Control Engineering Series No. 52, Peter Peregrinus, Stevenage.

Richard.Gonzalez@na.amedd.army.mi