Aging and Complexity in Equilibrium Dynamics

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Abstract

With increasing age, the fractal dimension of the graph of postural stability decreases.

From the many aspects of aging, the possible loss of complexity of certain physiological functions and processes is seldomly discussed [3, 4] and less well understood. We report here findings related to the loss of complexity, as documented by the decrease of the dimension associated with the graph of equilibrium dynamics with increasing age.

Graphs of postural stability are quite easily obtained by placing the test persons on a platform and asking to stand in an upright straight position. The upright position of humans is constantly endangered by small drifts and motions. To counter this tendency to leave the upright position, the tilt-dependent bodyweight difference between the stressed left or right feet is registered by a posturographic platform. The platform is a device which records the force exerted by the test persons to keep standing still and upright. The vector of the force difference stressing the left and right feet describes twodimensional temporal graphs orthogonal to the upright position of the test persons' body in space.

The fractal dimension of the graphs can be specified to the dimensional parameter obtained by the usual box counting methods [5, 1, 2, 6].

In figure 1 several graphs of equilibrium dynamics and their associated dimensions are drawn. In figure 2 the dimensions are plotted against the year of birth of the respective test persons.

In summary, while the results are preliminar and more data are necessary to draw a definite conclusion, the data reveal a clear anticorrelation between age and dimension and, if dimension is taken as a reasonable measure for complexity, also a clear anticorrelation between age and complexity of equilibrium

Figure 1: Several posturographs of different test persons and the associated dimensions D.

dynamics. One conceivable reason for this loss of complexity is the overall functional and structural loss of sensory and neuro-muscular elements involved in the maintenance of the postural stability in space.

References

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Figure 2: Plot of the dimension D of posturographs versus the year of birth of the respective test persons. The solid line represents a least-squares linear fit.

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