

Stochastic Models for the Variation of Positions Fixed by a Silkworm's Body during Cocoon Construction

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We have tried to fit a theoretical probability distribution on the unit sphere to body directions of a silkworm during cocoon construction, building a time series model for the change of the position fixed by the silkworm.

Behavioural data used here to build stochastic models were obtained by the experiment where we used a silkworm (race : Okusa× Kojiki) marked 15 points on its body. Positions of the marks on the silkworm's body were measured three times and their means were used for analysis. Then, we transformed the data by using the centre and major axis of an ellipsoid fitted to positions of spinneret for two hours. Determining direction of the silkworm's body from the tail end towards the 7th mark, we regarded them as locations on the unit sphere that were expressed by angles θ and ϕ .

The Fisher distribution we have used as a model for the variation of silkworms' body directions is a fundamental probability distribution on the sphere, corresponding to a normal distribution on the line. We revealed that a mixture model of these Fisher distributions suitably expressed dispersion of the mean direction of hind parts of a silkworm's body.

In addition, an autoregressive model was fitted to a series of positions of 7th part of a silkworm's body to represent the characteristic of the body movement. That model was deemed satisfactory as the comparison of real correlograms and reproduced correlograms from model.