

## **Analyzing and modeling red flour beetle movement in fragmented landscape**

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### **Abstract**

Red flour beetle is a common insect pest that infects stored grain. The study of individual beetle movement is important for better pest control in flour mill. In the biological experiment, red flour beetles were traced in an arena fragmented with flour patches. After analyzing the circular data from the experiments, a von Mises distribution was found to fit the turning angles of walking adult beetles well. A wrapped normal distribution also fit the data well, and was faster to compute than the von Mises distribution in simulation purpose. The move lengths are fitted adequately by a lognormal distribution. However, strong autocorrelation among turning angles and strong cross-correlation between move length and turning angles were detected. An additive nonlinear ARX time series model is proposed to characterize the direction and speed of individual beetle movement, and it is adapted to fragmented landscape. Local polynomial fitting scheme was used to estimate the functional structure. This paper is a part of the research project for simulating beetles with an agent-based model.