



Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Hive Simulation

Stefan Gugler, Elias Huwyler, Fabian Tschopp

December 15, 2013

Outline

Introduction

Description of the Standard Model

Environmental Influences

Summary

Outlook

Introduction

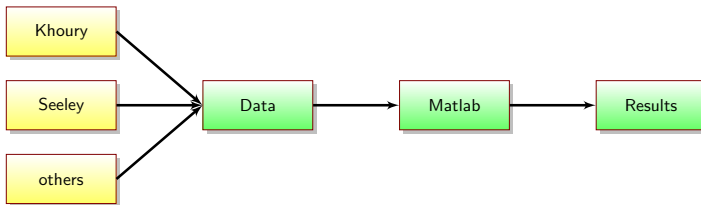


Figure 1: *Diagram of our work [khoury13] [seeley95].*

Description of the Standard Model

It consists of four differential equations:

- Change of brood number
- Change of hive bee number
- Change of forager bee number
- Change of food

Let's look into one equation: **Change of brood number**

$$\frac{dB}{dt} = LS(H, f) - \phi B \quad (1)$$

- L is the laying rate of the queen
- S is the survival rate
- H is the amount of hive bees
- f is the amount of food
- ϕ is the adult bee emerging factor

Environmental Influences

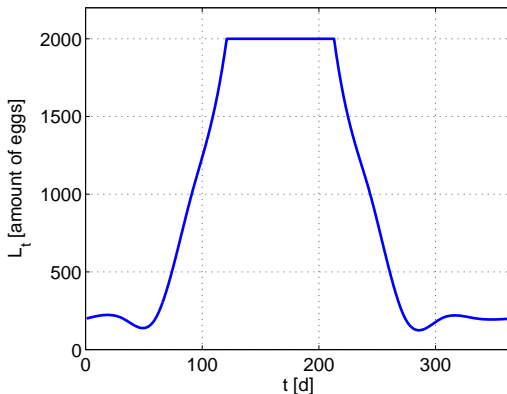


Figure 2: *The laying rate of the bee queen plotted over a year.*

Comparison between the environment dependent equation and the standard one:

- static equation: $\frac{dB}{dt} = LS(H, f) - \phi B$
- dynamic equation: $\frac{dB}{dt} = L_t S(H, f) - \phi B$

→ small changes in the formulae have significant effects (cf. Discussion).

Summary

- Standard Model after *D.S. Khoury*.
- Advanced Model: Environment simulation
- Autumnal shift is indifferent
- hive is rather stable
- Model restrictions

Outlook

- Better understanding of bees' and hives' behaviour
- See the importance and limitations of simulations
- Extend simulations

The background of the slide features a honeycomb pattern of hexagons. The top and bottom sections consist of bright yellow hexagons with black outlines. A horizontal band of dark green hexagons with lighter green outlines runs across the middle, serving as a background for the text.

Questions?