Introduction

construction by directed growth

Seed Factory

Growth Engine

Computational Garden

Seed Factory

Seed Factory

Growth Engine

Computational Garden

environment

environment

multi-organism
cyber-physical artefact

interface

subsystem genomes

Garden

Garden

Growth Engine

Growth Engine

phenotype specification

genome

environment

environment

growing organism

growing organism

phenotype

grown

specifications

are

input;

the

search

process
develops

the

relevant

seeds

(subsystem

genomes);

it

uses

the

Growth

Engine
to
grow

candidate

seeds

into

phenotypes,

which

it

evaluates

against

the

specification,

and

feeds

the

information

back

into

to

its

search

process.

Growth Engine

A

Growth Engine provides

the

computational

mechanisms
to
grow

a

seed.

This

might

be

required
to
grow

in

simulation

a

seed

intended

for

a

physical

device,
or

to
grow

the

seed

of

a

virtual

component

such

as

a

software

control

system.

Introduction

Our vision is

controlled

growth

through
gardening

macroscopic
cyber-physical

artefacts

formed

from

a
growing,

integrated

combination

of

material

and

virtual

subsystems.

Our

GROCPHY architecture comprises

three

major

components:

1. a Seed Factory, a process for designing specific computational seeds to meet cyber-physical system requirements;
2. a Growth Engine, providing the computational processes that grow physical seeds in simulation, and grow virtual seeds into software;
3. a Computational Garden, where multiple seeds can be planted and grown in concert, where virtual seeds can be interfaced with embodied growth processes, and where a high-level gardener can shape the whole into complex cyber-physical systems.