Automated Software Transplantation

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Why

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Related Work

Clone Detection
Feature Location
In-Situ Code Reuse

Code Migration
Code Salvaging
Synchronising Manual Transplants

Dependence Analysis
Feature Extraction
Automatic Replay Copy-Paste

Automated Error Fixing
Manual Code Transplants
In-Situ Code Reuse

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Related Work

Miles *et al.*: In situ reuse of logically extracted functional components

In-Situ Code Reusual

Debugger

Binary Organ

Running Program
Related Work

Sidiroglou-Douskos et al.: Automatic Error Elimination by Multi-Application Code Transfer

Automatic Error Fixing

Host

Donors
Related Work

Autotransplantation
Human Organ Transplantation

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Automated Software Transplantation

Manual Work:
- Organ Entry
- Organ’s Test Suite
- Implantation Point

Donor
- ENTRY
- Organ

Host

Organ’s Test Suite

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μTrans

Stage 1: Static Analysis
Stage 2: Genetic Programming
Stage 3: Organ Implantation

Host
Donor

Organ’s Test Suite
Host Beneficiary
Stage 1 — Static Analysis

Donor

ENTRY

Vein

Organ

OE

Matching Table

Dependency Graph

Donor: int X -> Host: int A, B, C

Implantation Point

H

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Stage 2 — GP

Algorithm 1

with a probability of 0.5. We define two custom, crossover

vectors, but convergence was too slow. Adopting union sped

ventional fixed-point crossover on organ and vein statements

variables used in donor at

generates new individuals. At the end of evolution, an organ

reproduction. Parents must be compilable; if the proportion

statement, weighted by the frequency of that statement's

addition and replacement operations, one for each unique

statement. In essence, the over-organ defines a large set of

replace, it overwrites the statement at

index into the over-organ's statement array. To add, it inserts

list. When adding or replacing, it first uniformly selects a

First, it uniformly picks

operator selects it, the resulting individual will be more fit.

. . . ' . The correct mapping is

organ test suite. Say the remap operator chooses to remap

not a valid array length in

our running example, say an individual currently maps the

to its parameters with a type compatible alternative. In

replaces a binding in the organ's map from host variables

parents. The use of union here is novel. Initially, we used con-

its parents' and whose

only one o

rately applied to the organ's map from host variables to organ

organ's parameters. We then uniformly select one statement

Input

choose

P

returns an element from a set uniformly at random.

S

p

D

O

H

µ

hit_eof

idct

V

V

V

V

S

S

S

V

V

V

V

S

S

S

...
Research Questions

- RQ1: Do we break the initial functionality?
- RQ2: Have we really added new functionality?
- RQ3: How about the computational effort?
- RQ4: Is autotransplantation useful?
Research Questions

RQ1: Do we break the initial functionality?

RQ2: Have we really added new functionality?

RQ3: How about the computational effort?

RQ4: Is autotransplantation useful?

Empirical Study

15 Transplantations
300 Runs
5 Donors
3 Hosts

Case Study:

H.264 Encoding Transplantation

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Subjects

- Minimal size: 0.4k;
- Max size: 422k;
- Average Donor: 16k;
- Average Host: 213k;

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Type</th>
<th>Size KLOC</th>
<th>Reg. Tests</th>
<th>Organ Test Suite</th>
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Experimental Methodology and Setup

Count LOC CLOC

Host
Implantation Point

Donor
OE

Validation Test Suites
Coverage Information: Gcov

Organ’s Test Suite

x 20
GNU Time

Ubuntu 14.10, 16 GB Ram
8 threads

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## Empirical Study

### RQ1,2

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<th>Acceptance</th>
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### TOTAL

- **Passed**: 188/300
- **Regression**: 233/300
- **Regression++**: 196/300
- **Acceptance**: 256/300

**UCL**

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Empirical Study

RQ3

### Timing Information

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Case Study

RQ4

MSU Sixth MPEG-4 AVC/H.264 Video Codecs Comparison, with ~24% better encoding than second place.

Doom9's 2005 Codec Shoot-Out

Second Annual MSU MPEG-4 AVC/ H.264 Codecs Comparison

<table>
<thead>
<tr>
<th>Test Suites</th>
<th>Regression+Acceptance</th>
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| H.264       | 100%                  | 100%
**Validation**

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