

EVOTEST

Scope

Complex systems exhibit emergent behaviour which makes them hard to predict. This presents particularly challenging problems during testing. However, this is a challenge that simply cannot be avoided: testing is a vital part of the quality assurance process. With important partners from Spain (ITI), UK (Kings College), France (INRIA), Germany (Fraunhofer, Daimler, BMS), Bulgaria (RILA) and Greece (European Dynamics), Evotest aims to attack the problem of testing complex systems using evolutionary algorithms.

Evotest addresses a fundamental problem European software industry is facing: *quality assurance of complex software systems*. It does so by combining various visions of the IST programme: a multidisciplinary approach to evolving, adaptive and automated testing as a solution to some of the challenges of mastering complexity in software development. This will be achieved by the development, application and evaluation of *Evolutionary Testing* techniques. Evolutionary Testing is an exciting, novel, nature-inspired solution, which transforms testing into an optimization problem. To increase the test efficiency for complex systems Evotest will develop an *Automated Evolutionary Testing Framework*. This framework will enable fully automatic generation of high quality test cases with high error detection probability. Automation is widely regarded as the key to test efficiency.

Evotest, Why? There is strong empirical evidence that deficient testing of both functional and non-functional properties is one of the major sources of software and system errors. Even though many test automation tools are currently available to aid test planning and control as well as test case execution and monitoring, all these tools share a similar passive philosophy towards test case design, selection of test data and test evaluation. They leave these crucial, time-consuming and demanding activities to the human tester. This is not without reason; test case design and test evaluation are difficult to automate with the techniques available in current industrial practice. The domain of possible inputs (potential test cases), even for a trivial program, is typically too large to be exhaustively explored. One of the major challenges associated with test case design is the selection of test cases that are effective at finding flaws without requiring an excessive number of tests to be carried out. This is the problem which Evotest directly attacks.

Advances

In the area of *software and systems engineering*, Evotest will contribute to new procedures and life-cycle processes that indicate how and when Evolutionary Testing could be applied to various testing problems and testing objectives. Moreover, Evotest will enlarge the view of existing software and systems engineering techniques by combining some of them in new ways not investigated before, e.g. the application of program transformation techniques for improving the testability of systems, the use of slicing techniques to reduce the size of the search

space, or the use of reliability analysis to control the test effort.

In the area of *software testing*, Evotest will result in new and evaluated test case generation techniques for various types of testing objectives that: (a) do not depend on the existence of a formal specification or model; (b) can cope with the often present unpredictable behaviours of complex systems; (c) cover the testing needs for industrial applications; (d) obtain high test coverage; (e) allow complete test automation; (f) execute the system with a large set of error-sensitive tests usually not achievable with established testing procedures.

Positioning in global context

One of the key issues in IST concerns the quality of software systems, or rather, the lack of it. Since the number of products and services that depend on software is growing, poor quality can significantly affect society. A lack of quality can reveal itself in a number of ways, like non-functioning features, operating system failures, erroneous outputs, unfulfilled time constraints, loss of service, etc. These faults can have various consequences that range from customer dissatisfaction to physical damage of the environment. Even considering the lesser of these effects, defective software gives rise to high maintenance costs for the company that develops it, thus making it lose its competitive edge or even leading it to bankruptcy.

Evotest addresses this fundamental problem European software industry is facing: *quality assurance of complex software*. It does so by combining various visions of the IST programme: a multidisciplinary approach to self-organizing, evolving, adaptive and automated testing as a solution to some of the challenges of mastering complexity in software development.

Target users / sectors in business and society

Creating quality products, satisfied customers and a good business reputation while saving money and time, are known ingredients for competitiveness for SMEs as well as large companies.

SMEs would never have the chance to develop or validate such a complex technology on their own. Consequently, Evotest is the only opportunity for SMEs to get in touch with this revolutionary testing technique.

However, even for the few organizations with a strong and mature software testing approach in place, Evotest results will have a significant impact. The evolutionary approach allows for automated test case generation that is optimized to meet a wide variety of test criteria, which makes the approach highly flexible and widely applicable.

Overall benefits for business and society

The Evotest project will have a major impact on software development with a consequent improvement of the competitiveness of the European software industry because it addresses the problem of software testing which is known to consume as much as 50% of the software development costs.

Poor quality software is a major cause of societal problems both world wide and within Europe. For example, considering just a single well-known European example of software failure, the direct cost of the Ariane 5 disaster was € 370,000,000. In 2002, NIST estimated the cost of software failure to the US economy at \$60,000,000,000; an astonishing 0.6% of GDP. The same report found that more than one third of these costs of software failure could be eliminated by an improved testing infrastructure.

In addition to the raw cost to European member state economies, European and global society faces other problems from poor quality software and inadequate software testing. The increasing use of software in safety critical environments, such as tools, transport, the home, workplace and in healthcare make software testing vital to the well-being of society.

Examples of use

Evotest will produce techniques to automate the process of software test data generation. Automated test data generation is crucial to the growing software industry and is a vital part of its competitiveness.

Software is increasingly an important part of product development for many companies. Considering Daimler vehicles, in the 1980s onboard software was confined to very small role in engine control alone. In the early 1990s, however, embedded systems already accounted for 1 MB of onboard software. By 1998, this figure had risen to 100 MB and in 2005 the figure has quintupled to 500 MB for the most complex vehicles.

The Daimler experience is not atypical. As another example, in the late 90s there was very little software in mobile phones. During the period of 1997 to 2001 the size quadrupled to more than 1 million lines of code.

Achievements

The Evotest Automated Evolutionary Testing Tool.



title

Evolutionary testing for complex systems

contract number

033472

type of project

Specific Targeted Research Project

contact point

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EC contribution

2 292 000 €

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duration

36