An Interview with Hans-Paul Schwefel

with an introduction by Günter Rudolph

Hans-Paul Schwefel, Universität Dortmund, hps@udo.edu

The sounds of Sputnik from its orbit around the earth in 1957 were the origin of the young Hans-Paul Schwefel's desire to become a space traveller. In thoughtful preparation he soon began his studies in Aero- and Space Technology at the Technical University Berlin (TUB). But while he was junior assistant at the Hermann-Föttinger Institute for Hydrodynamics at TUB another event changed his plans: In the 1960s difficult multimodal and noisy optimization problems from engineering sciences awaited their solution at the TUB. At that time mathematical models or numerical simulations of these particular problems were not available. As a consequence, the optimization had to be done experimentally with the real object at hardware level. The three students Peter Bienert, Ingo Rechenberg and Hans-Paul Schwefel (HPS) envisioned an automated cybernetic system that alters the object parameters mechanically or electrically, runs the experiment, measures the outcome of the experiment and uses this information in the context of some optimization strategy for the decision how to alter the object parameters of the real object for the experiment in the subsequent iteration. Obvious candidates for the optimization methods in the framework of this early 'hardware-in-the-loop' approach were all kinds of gradient-like descent methods for minimization tasks. But these methods failed. Inspired by lectures on biological evolution they tried a randomized method that may be regarded as the simplest algorithm driven by mutation and selection—a method nowadays known as the (1+1)-Evolution Strategy. This approach was successful and this event may be seen as the trigger that turned the career of HPS towards the emerging scientific field of evolutionary computation (EC).

After diversified episodes of his professional and scientific life he became full professor of Computer Science at the University of Dortmund where he was holder of the chair for Systems Analysis since 1985. From this position he gave birth to the now well-respected conference series on 'Parallel Problem Solving from Nature' (PPSN) and he was the driving force of establishing the 'Collaborative Research Center on Computational Intelligence' at the University of Dortmund. In addition to his numerous pioneering contributions to the field of EC he also served as a valued teacher and mentor for many master's and PhD students, quite a few of them now extending and propagating his work from positions all over the world.

Hans-Paul Schwefel received numerous rewards, most notable probably the IEEE Fellowship in 2005 and the honorary degree of Doctor of Science from The University of Birmingham (UK) in 2007. Although officially retired since February 2006 he is still active in the EC community and regularly seen in his university office. So we may be excited about the things still to come ...

Günter Rudolph, TU Dortmund University

Q Everybody knows the enormous influence you had in our field. Would you summarize the key ideas of evolutionary strategies in 2-3 paragraphs for someone unfamiliar with the field?

The key idea is a biologically plausible internal mechanism for adapting the variation strength since all efficient numerical optimization techniques do have at least some step size control. Eigen's paradox demonstrates that biologists had problems in understanding how mutation rates could adapt for DNA lengths necessary for even simplest reproductive organisms. I found an explanation and used it for the first 'self-adaptive' multimembered evolution strategy in the early 1970s: sufficiently high birth surplus and medium selection pressure and finite life span (or reproduction cycles per inidividual). The result was the well-known (mu,lambda e.g. 10,100) truncation selection EA. Recombination enhances the process, but it works (and in nature first worked) also without it.

Several other principles beyond mutation, recombination, and selection are worth to be studied and used for natural computing, e.g., gene duplication and gene deletion, polyploidy, multicellularity, gender dimorphism, multi-population, and multi-species schemes.

For multiple criteria conditions (the common case in nature) a predatorS-prey model is appropriate. It also helps to avoid idling processors in grid/cloud computing by means of asynchronous birth/mating/death processes.

Q What experiences in school, if any, influenced you to pursue a career in science?

At and after (1959) school, I did not pursue an academic career. It just happened to me. Enchanted by Sputnik 1, I wanted to become an astronaut visiting distant sites in the universe. But because Lufthansa and Air France did not agree in time about pooling their pilot schools (I passed all qualifying examinations), I started studying aero- and space technology. One year later, I could have started a pilot's career, but meanwhile the university studies fascinated me and let me dream of engineering my own spaceship (ask my wife, she will certify that I promised to take her with me into space).

Q Who are the three people whose work inspired you most in your research?

Wernher von Braun (I bought a copy of his dissertation about constructing missiles), Eugen Sänger (I aimed at becoming his assistant; Unfortunately he died shortly before I got my diploma), and Hermann Oberth - I did not miss any of their lectures at the Technical University of Berlin (TUB).

Later on I was fascinated by contemporary topics like cybernetics, bionics, and computers meeting pioneers like Karl Steinbuch (Lernmatrix, artificial neural networks), Heinrich Hertel (my professor for aircraft construction, teaching to look for structures, forms, and movement in nature, e.g., blades of grass and dolphins), and Konrad Zuse (whose Z23 computer was the first one at the TUB; I used it already for my diploma thesis about simulating evolutionary processes on discrete optimization problems in 1965).

Q What are the three books or papers that inspired you most?

1958: Wernher von Braun & Willy Ley: Die Eroberung des Weltraums (The conquest of space)

1959: Teilhard de Chardin: Der Mensch im Kosmos (I had thought it would deal with 'man in space', but it dealt with organic and spiritual evolution. In French the title was 'Le phénomène humain', which I recognized only later. The book was on Rome's index when I bought it in 1963).

1965: Wilhelm Fucks: Formeln zur Macht (That is why I became a futurologist when EAs did not pay - from 1976 to 1985).

Q As a founding father of this field, what is your own view about what evolutionary strategies are? What did you expect them to be?

A means of understanding 'real life' *and* an aid for experimental (later also computational) improvements.

Q What do you like most about evolutionary computation?

That they have become accepted after 30+ years, i.e. during my life, even by many skeptic theoreticians.

Q Conversely, what do you dislike most about evolutionary computation?

That bio-inspiration has gone more and more into the background in search for efficiency instead of insight.

Q What is the biggest open question in the evolutionary computation area?

How to model further important features of organic evolution in search for understanding nature *and* improving algorithms.

Q Where do you see the evolutionary computation community going in the next ten years? Twenty years?

10 years: hyper-meta-'all-weather'-hybridization with classic optimization tools,
20 years: a class-room standard in engineering and management.

Q What are your favorite real-world applications of evolutionary strategies?

Experimental ones (without computers)

Q Your books and papers are sources of inspirations, is there any topic in your books and papers which you hoped people would take more seriously?

People should read carefully, not only cite from hearsay.

Q Which ones are the most misunderstood/misquoted?

There is nothing that has not been misunderstood by at least one 'researcher'.

Q If you could do it again, what would you do differently in your development of the evolutionary computation field?


“Je ne regrette rien!”

Q What new ideas are you (or former students) working on and excited about?


PredatorS-prey models for multicriteria (including constrained), dynamic, noisy situations

Q What new ideas in evolutionary computation are you excited about?


Two-gender models without and with mating selection

Q What books, tangentially related to the field, that you’ve read in the last year did you like the best?


Books of Daniel C. Dennett (Darwin’s Dangerous Idea) and Ernst Mayr (What Evolution Is, What Makes Biology Unique?) about evolution

Q You had many successful PhD students, what is your recipe for PhD success?


Don’t discourage them; ask questions like Socrates; give plenty of rope.

Q Your key advice to a PhD student?


Don’t follow the advice of elders, follow your intuition!

Q What advice would you give to students and beginning researchers who are starting to work in evolutionary computation?


Don’t follow my advice or my example, find your own way!

Q Has thinking about evolution changed your view on things in general?


Yes, indeed.