A t the end of 2005, the world of chess computers suddenly changed when an engine with the name of Rybka appeared from virtually nowhere. At the prestigious International Paderborn Computer Chess Championship the new program by the American developer Vaclav Rajlich – whom everybody simply calls Vasik or Vas as his first name – won a clear point ahead of established machines such as Zappa, Spike, Shredder, Fruit or Jonny. Out of the blue, Rybka skyrocketed to the top of the Swedish computer ranking list, which had been regarded for a long time as the equivalent of the FIDE rating list in the chess computer sector (cp.http://web.telia.com/~u85924109/ssf/df/). However, chess computer experts now regard the results of other test teams as more reliable (e.g. http://www.husvankempen.de/nunn/ or http://www.computerchess.org.uk/ccrl/ 404)). Depending on hardware, Rybka surpasses every other program by 60 rating points at least, and is the first engine which has established itself beyond the 3000 Elo rating barrier. Among top players, Rybka is increasingly regarded as an added value to the engines they traditionally use; Alexander Morozevich even gave Rybka the highest score in his voting for the Chess Oscar 2005 and put forward allegations that the ‘Topalov team’ might have used this tool for cheating activities.

Therefore, it is high time to get first-hand information from the man behind the machine. The place to meet Rajlich was the Hungarian capital of Budapest, and the visit also offered a unique opportunity to peek over the shoulder of his team in order to watch the man-machine interaction during a freestyle qualification tournament.

From computer freak to chess couple

In a few years time Rajlich’s career might be described as a typical American rise from rags to riches. However, this time the American has left the States to try his luck in ‘old’ Europe. He describes his life-long shuttle across the Atlantic: “I was born in Cleveland in 1971 where my Czech parents were studying at the time. My father is a mathematician and later worked in the computer field. My mother is also a trained mathematician. I have two younger brothers. We moved back to Prague when I was three weeks old and stayed in the Czech Republic until I was 11. The whole family moved back to the USA at that time. I studied computer science at MIT (Massachusetts Institute of Technology) near Boston and worked as a software developer at Texas Instruments (Dallas, USA), Triada, a company specialized in data compression, (Ypsilanti, USA), Ford (Detroit, USA), at the Environmental Research Institute of Michigan, which was developing radar imaging systems (Ann Arbor, USA), and Option, a leading company in the field of wireless communication technology (Adelsried, Germany), over the last thirteen years. Now, I am working full-time on Rybka in Budapest, Hungary.”

He came over to Europe mainly in order to pursue his chess career after he was fascinated by the royal game comparatively late: “Chess was quite big in my family, mainly thanks to my grandfather on my father’s side, who was a very enthusiastic chess player in the Czech city of Tabor. I started to play tournaments quite casually at first, when I was about 20, and then went through a big chess phase in the period 1997 through 2003 or so. Now I am an international master.” Like most other ‘chess travellers’ he chose Budapest as a hot-spot for ambitious chess players.

However, the improvement of a sophisticated program also requires a lot of support from other sources: “There are tons of people who are involved in the project in various ways. My partner Convexa Ltd handles the business and marketing and develops graphic user interfaces on which Rybka runs. Jeroen Noomen from the Netherlands writes the Rybka opening book – this is an extremely competitive sub-discipline of computer chess which has quite an impact on engine results. My wife Iweta uses Rybka constantly and gives me feedback which I use to improve the engine. The Polish GM Michal Krasenkov is a member of our team in the freestyle events. Christoph and Felix Kling from Germany have developed the Rybka web site (www.rybkachess.com). In addition, there are dozens of other testers and test groups around the world who give me useful ideas and test results, and who create the objective test environments for chess engines, without which computer chess itself would not exist. The Rybka project would hardly be possible, at least in its current form, without all of this help.” The fundamentals can be traced back to his teenage years: “I’ve been programming my whole life, I wrote hundreds of programs before I even got to college. These programs included a Connect-4 program (a two-player board game in which players take turns dropping discs into a vertical grid, with the objective of getting four of one’s own discs in a line), this was my first experience with game-playing algorithms.” The idea of creating a chess program for professionals combined Rajlich’s hobby and skills he learnt at university. Nevertheless, it is not easy for him to define a chess programmer’s profile: “The main qualification is kind of
vague—it’s a sort of semi-mathematical thinking ability which is hard to pin down exactly. Some people just have it, others haven’t. Of course, it also helps to have software development skills and chess skill. My main interest in computer science has always been artificial intelligence, for instance, at ERIM we developed a system to identify features on radar images, etc. It had always been in the back of my mind that some day I would write a chess program. Finally, in January 2003, I got started, and immediately stopped doing everything else.”

Now the daily life of this Washington Redskins fan—and of the NFL in general—looks pretty much all the same in their small two-room flat in the centre of the Hungarian capital, some 200 meters away from the Danube and the famous Liberty bridge. “It very much resembles a chess engine. Rybka development goes through cycles which are roughly as follow: 1) get a new idea; 2) refine the idea, maybe make some preliminary experiments; 3) initial implementation of the idea and 4) testing. If you put a camera in my work area, mostly you’d find me sitting in front of my computer.” Rajlich knows that there is still a lot of work to do: “Rybka still lacks a few concepts which come naturally to humans. For example, Rybka lacks a true idea of contempt—that is, preventing a weaker opponent from achieving an easy draw due to too much simplification or blocking the position. Rybka will play against a peer the same way as it would against a patzer. So, yes, there are ways for a weaker player to play for a draw which are more effective than they should be. However, there are no especially good ways to play for a win.”

Optimization is one issue, integration of new functions is another area. As in other fields of chess learning, an instructive combination between didactic methods and user friendliness is required. Rybka as a ‘chess teacher’ should reveal more than an ordinary assessment by a single numerical value in the display. Implementation of a visual function is not an easy task, says Rajlich: “This is probably too complicated to get into in a short time. I’ve put together a preliminary design which involves for example the engine giving a score to each piece on the board. The graphic user interface would then display this score to the user via some sort of colour coding of the piece or the square it sits on. The knight on a3, on the other hand, is very difficult for Rybka’s evaluation to handle properly. There are potential outposts, but figuring out whether the knight can reach them and with what significance can only be properly determined via a search. So Rybka would give this knight higher and higher scores as the search proceeds, and the user would see the colour coding of the knight improve as the search gets deeper.”

Besides such dynamic functions, the main attention is targeted towards improvements in every phase of the game. So-called ‘freestyle’ tournaments, which are played man-machine versus man-machine, offer valuable insights on how to tackle these areas.

** Tournament games as test fields **

Iweta Rajlich describes how the ‘man-machine interface’ is organized when the heat of a one-hour game is on: “GM Michal Krasenkov is our team captain and he decides which move we play. He sometimes asks about our opinions. Vasik and I try to discover an interesting route and ask Michal what he thinks about it, or he comments on the ideas which we can see on his screen. Each of us has his own Rybka (with different hardware: 4 processors plus 2 parallel 1 processor machines for Michal, 2 processors for myself and 1 processor for Vasik). In addition to analyzing, Vasik is responsible for technical staff and avoiding mouse slips, and it is his responsibility to have in mind that we need to eat from time to time. To sum up, we work pretty much individually on positions and then we summarize our ideas; sometimes Michal divides up work and we test what he suggests. In the opening and early middle game as well as in the endgame we tend more to override the Rybka engine more often than in the middle game. White’s moves g6! and h5 in the game Rajlich-Intragrand are human discoveries (included below as part of the analysis of Rajlich-Kingscrusher).

Furthermore, we are using Rybka to go deep into tactical lines. If the position is rather strategic (I mean with little tactics) we try to choose a plan. For instance, in the game of Poweroff with the white pieces against Rajlich in the final of the 3rd freestyle competition, we had a very difficult position, and in order to save the game Michal came up with a clever idea of exchanging knights for the cost of another pawn. The game transposed into opposite-colour bishop endgame where Poweroff (who played as an unattended Rybka) had two pawns more. I don’t have to mention that sacrificing a pawn for an idea which appears in 20 moves later in a drawn endgame is even beyond the reach of Rybka.”

The above position is meant to illustrate the idea that positional evaluations change as the search gets deeper. Rybka’s static evaluation has no trouble understanding that the bishop on c8 is a bad piece, so this bishop will be consistently reported as a bad piece, regardless of how much searching is done. This will be indicated to the user via some sort of colour coding of the piece or the square it sits on. The knight on a3, on the other hand, is very difficult for Rybka’s evaluation to handle properly. There are potential outposts, but figuring out whether the knight can reach them and with what significance can only be properly determined via a search. So Rybka would give this knight higher and higher scores as the search proceeds, and the user would see the colour coding of the knight improve as the search gets deeper.

- **33... Ëe5**

A human GM move—i.e. it is to exchange knights and defend the opposite-coloured bishop endgame being two pawns down.

- **34 Ëxe5 Ëxc5 35 Ëf1 Ëe7 36 Ëd3 h6 37 Ëg4 Ëe5 38 Ëf2 Ëf8 39 Ëf4**

The c3-pawn will be lost but more pieces will be exchanged and the black square blockade will remain.

- **39... Ëe5 40 Ëe4 Ëf6 41 Ë xc7 Ëxc7 42 Ë e4+ Ëf8 43 Ëh7 Ëg7 44 Ëf5 Ëe5 45 Ëh5 Ëa7 46 Ëf3 Ëc7 47 Ëg2 Ëh2 48 Ëf4 Ëg7 49 Ëxc3 Ëxc3+ 50 Ëxc3 Ëf5 51 Ëh3 Ëa3 52 Ëe8 Ëf6 53 Ëd7 Ëe5+ 54 Ëd3 Ëa3 ½-½**

It looks as if the subtleties of endgame strategy are still a domain where human intuition is superior to more long-term thinking is required. A game against the Australian Fredi Z demonstrated that engines sometimes follow rules which human would not really consider. Rajlich tries to explain this phenomenon: “Engines, Rybka included, are relatively weak compared to humans in the area of understanding the choices of drawing in endgames where one side stands nominally better.
They will often fail to simplify to the right kind of inferior endgame (i.e. one that is defensible), or they will be too happy to allow such a simplification. This second case is what happened in the game with Fredi Z, who was using an automated Rybka. Rybka stood better, but needlessly allowed a trade of the white b-pawn for the black e-pawn, after which there is no serious danger of us losing. Of course, Rybka understands that it is not good to trade those pawns in general, but for Rybka in the position here this was overruled – incorrectly – by other considerations.

Fredi Z – Rajlich
4th Freestyle (Qualification) 2006

1 e4 c5 2 d3 d6 3 c3 e6 4 d4 cxd4 5 cxd4 f5 6 e5 d5 7 f4 c6 8 d5 a6 9 a3 b5 10 d5 e7 11 fx6 fxe6 12 c3 e7 13 fxe6+ gx6 14 d3 d5 15 w2 d4 16 cxd4 wdx4 17 0-0!

It is time to take a crucial decision as White deviated from a previous game by Krasenkov. After White castled kingside, Black has the option to castle kingside or to play g8. The Rajlich team took its time to scan the position in order to identify drawish lines. In this process they overlooked the unexpected move c2 which leaves the b2-pawn en prise. Maybe this was caused by Vasik’s statement that 18 h1 is the most likely move or their search was mainly influenced by the stem game with 17 0-0-0 wb6 18 wc3 wxc3+ 19 fx3 w8 20 w2 d7 21 f3 w6 22 c2 c8 23 w4 d6 24 c5 c8+ 25 c1 f5 26 exf5 h6 27 c4 cxd5 28 exd5 h2 29 f6 d7, and Black won in Socko-Krasenkov, Bundesliga 2003.

17 ... w8 18 c2!

The engine excels at top level!

18 ... wb6
18 ... wbxb2 19 wdb2 axh3 (19 ... b4 20 ab1 wc3 21 wc3 a5 22 wc1 w6 23 cxb4 w4 d4+ 20 wc1 xg2 21 f3 wh3+ 22 wh1 axg2 23 wxb4 wxb2 25 b1 d2 26 db1 c6 27 wb1 c4 would be a worst case scenario for Black.

19 a4!

The human players expected this move and started to search for paths to split the point (in particular, in a forced endgame with a white passed pawn in the b-line). In addition, they received information that their opponent was using hardware with two processors which compared to the second best computer among the four machines in the Rajlich team.

19 ... g4 20 wc3 wxc3 21 af3 d8 22 af4 wg4

The difference on the clock was striking: so far White had used 10 minutes whereas Black had already spent 45 minutes (of an hour’s total)!

23 wfd1

This line was as early as move 19 at the screens in Budapest and the alternative was 23 whb1 af3 24 ab5 (24 w g6 25 axb5 axb5 26 axb5 w8) 24 ... axb5 25 axb5 wb8, which should save the game.

24 wxa4 f5 25 wxd6 we8 26 f3 w6

Krasenkov stated categorically: “We should no longer trust Rybka.”

27 wa1

They expected 27 wxg6 hxg6 28 exf5 wxf5 29 w2 d4.

27 ... wdg6 28 c2 wxb6+ 29 cxb6 c8 30 exf5 wxf5 31 wb5 wb2 32 wxe5 h6

Played without any hesitation as all endgames are likely to reach the play haven.

33 wd3 wd6 34 wff1 wd2 35 wc2 wd7 36 c1 wd4

“If we want a draw it is immaterial if we play the rook to d4 or b2.” (Krasenkov)

37 wc2 wc4 38 wb5 wd6 39 wa5 w8 40 g3 wc6

Krasenkov was already looking to the future: “Do we have the tablebase installed in case it will be rook versus rook and bishop?”

41 wc3 wd5 42 wdxd5

The human player knows that this facilitates Black’s task. However, an engine implements the rule that it has to exchange if it has extra material. This position illustrates the danger of playing a freestyle competition with an engine in automatic mode.

42 ... wdx5+ 43 wc4 w7 44 wd3 w6 45 g4 wd8 46 wc6 47 wd5 w7 48 h4 wh6 49 wd4 w7

Although White can no longer make any progress the game lasted 192 moves. White repeated moves and shortly before the 50 moves rule applied, the player advanced pawns to h5 and f5. Nevertheless, it was inevitable that the point would be shared.

\[ 1/2 \]

However, such ‘slips of the pen’ help to rethink endgame themes as in this case the rook versus minor pieces with pawns on one side. Rajlich concludes: “Well, we were discussing some endgames over breakfast with Michal Krasenkov, and I found out that there are certain things that I (and Rybka too) don’t really understand. For example, if both sides have 3 pawns on the f-, g- and h-files, and White has a rook while Black has two minors, Michal claims that Black’s winning chances are better if the minors are a bishop and a knight than if the minors are two bishops. You can easily convince yourself that Rybka thinks the opposite by setting up such positions and asking Rybka to evaluate them. Anyway, I haven’t had a chance to investigate this as it usually takes between two or three weeks to check something like this – nevertheless, I’ll need to see if this heuristic passes my tests.”

King security is the other field which still reveals impressive capacities of human brain. The g4-attack in the Shabalov line of the Slav has to be regarded as a model opening to put this issue to the test.

Rajlich – Kingscrusher
4th Freestyle (Qualification) 2006

1 d4 w6 2 e4 e6 3 f3 d6 4 c3 c6 5 e3 b6 6 0-0 g4 7 d4 cxd4 8 wxe4 b5 9 a6 0-0 10 e4

Krasenkov: “Should we play 10 e4?” Vasik Rajlich: “He might have prepared it, but not for us. And his analysis might not be so deep.”

10 ... we7!! 11 wb5 wh5? 12 wxe5+...
11 g5

After a previous encounter against IntraGrand in the 3rd Freestyle final, Michal Krasenkow explored the alternative 11 e5 in detail (cp. www.rybkachess.com). This piece of analysis makes plain the difference between decision-making as a centaur and over-the-board in a fight between human players. On-going interaction between man and machine enables the human player to delve far deeper into positions. If a top player properly shares responsibilities for sub-variations and more risky lines in his team, he can assess the potential direction of the game and reliability of promising candidate moves: 11 e5 Ìd5 12 Ìxd5 cxd5 13 Ìd3 (13 Ìxb5? Ìa5+ –+) 13 ... h6 14 h4 Ìb7 15 h5 f6 16 Ìh4 Ìc8 17 Ìwb1 (17 Ìh7+ Ìxh7 (17 ... Ìf7i) 18 Ìg6 mate) 18 Ìg6+ Ìxg6 20 Ìh7+ Ìf8 21 Ìxh6 Ìa5+ 22 Ìg1 Ìxh6 23 Ìxh6+ Ìd8 24 Ìg6+ Ìd8 25 h6!! (25 Ìg8+ Ìc7 26 Ìc1+ Ìe5!! 27 Ìg6 Ìc6 28 Ìxc5 Ìd2, Black’s king is safe. At a particular moment White will be in great danger! Although White has a nice material advantage he is in trouble.) 25 ... Ìxd2 26 h7 Ìc7 27 h8=Ì Ìxh8 28 rÌxh8 Ìxh8 29 Ìc1+ Ìc5y 30 Ìw2 Ìxb6 31 Ìb4+ Ìb1 32 Ìxh6 33 Ìc5 Ìxh6 34 Ìc5 Ìxg4 35 Ìc3 Ìe4 36 Ìc4+ Ìc6 37 Ìg5 Ìd5 38 Ìxh7+ Ìc5 39 Ìxg5 Ìf7 40 Ìd5, and White later won in Rajlich-IntraGrand.

13 0-0 Ìb6

Iweta checked 13 ... Ìwa5 14 Ìdb1 b4 15 Ìe5=+ which is a surprising silicon solution!

14 Ìd3 Ìd4 15 h4

15 h4 f6 16 g6 hxg6 17 Ìh1g1? (When the Rajlich trio analyzed the advance of the h-pawn they concluded that 17 ... Ìwa8 18 e5 Ìf5 19 Ìg3 with the idea Ìg1 is unlikely to happen, as it isn’t a good strategy. However, this appeared at the board later!) 18 Ìe3 b4 Krasenkow as “team leader” analysed 18 ... Ìxa6 19 hgx5 b4 20 Ìg2 Ìxe3 21 fxex3 Ìxd2 22 Ìxd2 Ìxg5 23 Ìe5c5 Ìc6 24 Ìg6 c4 25 Ìw2 Ìf2 26 Ìh1 Ìg7 27 Ìc5+ Ìg8.

15 ... Ìf6

Krasenkow: “A human player would know that you do not play such a move at the side where you are being attacked.”

16 g6 hxg6

16 ... h6 Vasik: “Rybka hates moves like this.”

17 Ìhg1

A strange but extremely efficient pawn sacrifice. Usually one would expect White to put his heavy pieces into the g- and h-file and then he “opens the gates” by removing the pawn.

24 ... Ìc8 25 Ìd7 Ìf7 26 Ìc1 Ìe6 (26 ... Ìd8 27 h6! Ìc6 28 Ìwa3 Ìxd7 29 Ìh7+ Ìxh7 27 Ìh6+ Ìf8 25 Ìd7 Ìd7 26 Ìc4 Ìd6 26 ... Ìc4 (26 ... Ìc4 27 Ìc3 Ìe4+ 28 Ìxh4 Ìe4 29 Ìxe4 Ìxe4 Ìxe4 30 Ìxh5 Ìe6 31 Ìxh6+ Ìf8 32 Ìxc7 Ìxe4 33 Ìd4 Ìe4 34 Ìe3 Ìe4 35 Ìc5 Ìd5 36 Ìd7 Ìxe6 37 Ìxe6 38 Ìxg5 Ìxe5 39 Ìxa5 Ìe7 40 Ìwd5, and White later won in Rajlich-IntraGrand.

24 25 ... Ìxe4+ 26 Ìxe6+ Ìxe6 27 Ìxe6 Ìe5 28 Ìg8+ Ìf7 29 Ìd4 Ìd5 30 Ìd3 Ìd5 31 Ìd3 Ìd5 32 Ìd5 Ìd5 33 Ìd5 Ìd5 34 Ìd5 Ìd5 35 Ìd5 Ìd5 36 Ìd5 Ìd5 37 Ìd5 Ìd5 38 Ìd5 Ìd5 39 Ìd5 Ìd5 40 Ìd5, and White later won in Rajlich-IntraGrand.

27 Ìd7

A panic move which one can expect from a human, but not from an engine (Krasenkow).

30 Ìg5 Ìe5 31 Ìa7 Ìa7 32 Ìa2 Ìd6 33 Ìd4 Ìg8 34 Ìd2 Ìa8 35 Ìf4 “We should play normal stuff. Rybka will go for the win of the c4-pawn.” (Vasik)

35 ... Ìxh7 36 Ìwd2 Ìc8 37 Ìxe4 Or 37 Ìh5 Ìh7 38 Ìc6 Ìc6 39 Ìc6 Ìc6.

37 ... Ìc6 38 Ìc6

Just for fun a “Zugzwang” move 38 ... Ìwd7 39 Ìwd3 Ìa4 40 Ìwd4 41 Ìwd3 Ìb8 42 Ìc4 1-0

Concerning the learning effect Rajlich points out: “Yes, these games were quite similar. In both of them, Black tried to free his position and get counterplay by playing f6, expecting an exchange of our g5 pawn for Black’s f-pawn, and in both cases we played the speculative but apparently strong pawn sacrifice g5-g6. In both cases, Rybka evaluates the situation similarly – it thinks that White is better after the pawn sacrifice, but considers the advantage less than if Black hadn’t provoked the sacrifice in the first place with f6. It’s hard to give any general rules for this – these sacrifices certainly can’t be said to work ‘just in principle’, the positions are far too complex for that. It does seem, though, that these are two examples where Rybka’s sense of balance between material and king safety turns out to be not quite correct.” Although the advertising phrase ‘Rybka is a revolution in computer chess’ correctly hits the mark, human players still take comfort from having some creative scope for development – at least.