Robert Remembers: The Ukranian Egg

by Robert McDermott

For more than 28 years, a 3 story high Easter egg monument has dominated a stretch of Canadian highway. This is the story of the Veggreville Ukranian Easter Egg's origin in Utah.

Crafted with precision and expertise, it stands today not only as an icon of a community, but the first complex, full-scale physical structure starting from a computer model. Another first was the use of B-spline curves in modeling an underlying egg shaped surface; the supporting computer aided design software was written entirely from scratch.

The town of Veggreville, Alberta is the largest Ukranian community in Canada. Steeped in tradition and culture, the town leaders sought a monument to celebrate their heritage. In 1973 they submitted an application to the Alberta Century Celebration Committee to erect a giant Pysanka (Ukranian decorated Easter egg) to commemorate the 100th anniversary of the Royal Canadian Mounted Police. The egg would stand as a symbol of the peace and security brought by the R.C.M.P.

Having secured the funding, the project organizers turned to the actual construction of the egg. They quickly discovered that no one could design a geometric egg shape of the scale they desired. Finally they contacted Ron Resch, a research associate professor and industrial designer at the University of Utah. Resch had been working with geometric patterns and folded plate systems and seemed a likely candidate to solve their design and construction problem.

Before enrolling as a student at the University of Utah, I had met with Ron. I was excited at the idea of working with him and finding a project that would allow me to learn a great deal and produce something of significance. The Easter egg project was the ideal opportunity. It would allow me to combine my existing interests in design, sculpture, mathematics, computer science and computer graphics with wonderful faculty influences to produce a successful project as well as complete my PhD thesis.

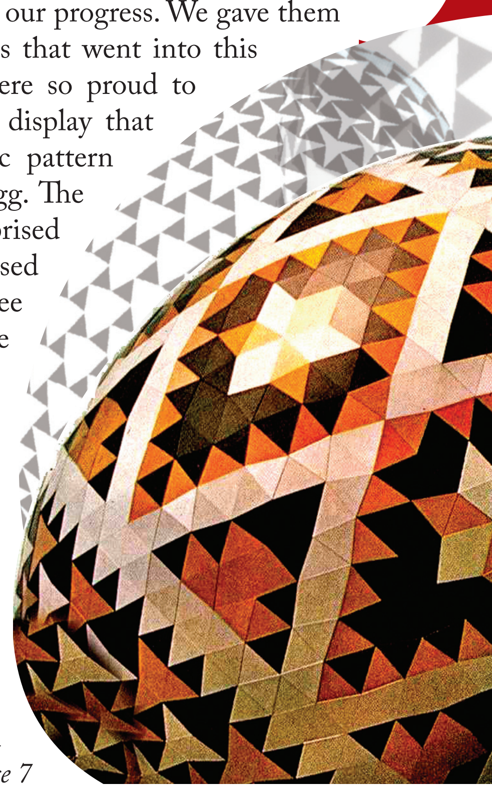
The project was an incredible task. The egg project would consist many different steps.

The first step was to find the exact curvature of an egg, At the time there was no mathematical definition for an egg. I found an egg grading manual that helped me to sketch the shape on graph paper. After producing three foot plotter drawings we discovered that shape of an egg was more of symbolic image than a replicated image.

Ron proposed a conceptual solution that would distribute equilateral triangles on the eggs surface. At the time there was no such thing as computer aided design software so we produced our own. Jim Blinn (PhD '78) and I were responsible for the mathematics and computer programming that went into the proposed solution for Ron's geometric system.

Each sheet of aluminum was engraved with its position and color coding, they were scored for the interior lines of pattern, holes were drilled, and finally the exterior lines of the pattern were cut. Ron modified a robust Gerber plotter to complete the task. I was responsible for producing control tapes that would run the plotter.

During the design process, the Veggreville committee came to Utah to observe our progress. We gave them a tour of the many steps that went into this complex process. We were so proud to show them a computer display that contained the geometric pattern and coloration of the egg. The committee was surprised and somewhat confused when they asked to see the physical model of the egg, which of course did not exist. It took quite a while to explain that the model existed only in the computer.



Each of the 524 star patterns were produced on the plotter in-house, sent to Ogden for anodizing according to the three color code, then

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Supporting Standards by Formalization

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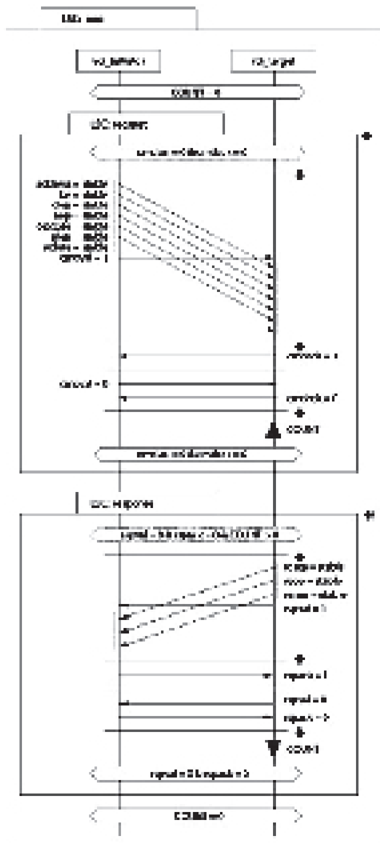
consequence bus standards, PCI, have become important. However, the very nature of the standards document is an impediment, due to its size and informality. There are few tools to help an implementer figure out whether an implementation conforms to the PCI standard. The PhD work of Annette Bunker (PhD '03) tackled this problem with a graphical way of specifying hardware protocols. The figure shows the PLSC representation of the PCI protocol, which formally captures 60 pages of English text in a single picture. Being visual, the specification is far easier to understand; moreover, Annette invented a way to interpret PLSCs as logical formulas which can be input into a model checker so that conformance with PCI can be automatically checked.

We have formalized the recent Advanced Encryption Standard (AES), replacing DES, the Digital Encryption Standard, which was getting old. The formalization of AES was in higher order logic, a mathematical specification language plus a system to do proofs in. A proof of functional correctness was carried out, along with extensions to encryption and decryption of arbitrary datatypes. The proof of correctness is quite straightforward: one runs the code on symbolic inputs, then checks that the decryptor faithfully inverts the scrambling of the encryptor. Testing such code is not in the realm of possibility at the moment, since 2^{128} tests would have to be carried out to get full assurance.



PLSC definition of PCI Protocol

Other work in the SoC has used higher order logic to specify a wide range of memory models. This is the in-progress PhD work of Jason Yang. He found that formal specifications can be much more concise and precise than natural language prose. For example, the Intel Itanium memory model specification is 30 pages of English text, while its formal specification fits neatly onto 3 pages. Besides concision, the advantage of formal specifications is that they can be directly used in automated tools to help people better apply standards.

Our work is part of a movement that will see future standards mathematically specified and supported by "conformance-checkers" based directly on the specification. Further, more standards may be specified in visual languages such as PLSCs and so should be better understood and used by the industrial practitioner.

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crated and shipped to Veggreville. The structure itself contains 524 star patterns, 2,208 triangular pieces, 6,978 nuts and bolts, and 177 internal struts. The total weight of the monuments is over 30,000 lbs and stands 31 feet tall.

I, however, did not help with the assembly of the egg. I was stuck back in Utah, turning this project into the basis of my dissertation. Knowing that the work that I had been doing would affect the lives of people so many miles away was a reward in itself.

While working on my dissertation I developed a collegial relationship with Steve Coons. He was a visiting professor at the university and became an advocate of mine and was significant in helping me overcome the struggles I faced in accomplishing my PhD. I was grateful for his wealth of knowledge and his unique approach to the quality of his work.

I can look back today and feel that the work was a job well done. It not only stands as a monument for the town of Veggreville, but as a piece of academic work completed as a computer science graduate student.

It was a great opportunity to work with such outstanding individuals as Jim Blinn, Ron Resch and Steve Coons to create something of visual significance that has lasted through the years.

Robert (PhD '80) is a Staff Scientist at the Center for High Performance Computing at the University of Utah and as an Adjunct Professor with the School of Computing. Contact Robert at mcdermott@chpc.utah.edu.