HISTORY OF THE FINITE ELEMENT CIRCUS

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The Finite Element Circus is a regular conference devoted to the theory and applications of the finite element method and related areas of numerical analysis and partial differential equations. The Circus was conceived by Ivo Babŭska, Bruce Kellogg, and Jim Bramble over beer and pizza at the Beltway Plaza shopping center in Hyattsville, Maryland in 1970, and the first circus was held at the University of Maryland, College Park later that year. Serious mathematical study of the finite element method was just getting underway and the Circus provided an important opportunity for those in the field to share current research.

The next Circus took place in the fall of 1971 at Harvard, hosted by Garrett Birkhoff. In March, 1972, the Circus was held at the University of Chicago. A partial list of speakers includes: Ivo Babŭska, Seymour Parter, Bruce Kellogg, Vidar Thomée, John Osborn, Jim Bramble, Jim Douglas, Garth Baker, Al Schatz, George Fix, and Gil Strang.

In November, 1973, the Circus was at Cornell and there were 14 speakers. These were, in order: Ridgway Scott, Ivo Babŭska, Michael Mock, Joel Dendy, Lars Wahlbin, Jim Bramble, Al Schatz, Bruce Kellogg, Alan Berger, John Osborn, Gil Strang, Rick Falk, Mary Wheeler, and Todd Dupont.

In October 1974, the Circus was back at the University of Maryland and in March, 1975, the Circus was again at Harvard. There was a Circus in November of 1975 (location not certain). In March of 1976, the Circus was at Brookhaven and then at Cornell in November of 1976.

The Finite Element Circus book (a gift of Mary Wheeler) begins in November of 1977 at the University of Maryland and documents the meetings of the Circus. The full book can now be viewed online at:

http://www.ices.utexas.edu/˜bass/outgoing/Compiled_Scan_of_The_Finite_Element_wCover.pdf

It is also available in smaller files separated into five year periods at

http://www.math.rutgers.edu/˜falk/fecircus/fecircus.html

The first entry in the Circus book reads as follows:

The Finite Element Circus held its fall meeting at the University of Maryland on November 11-12, 1977. 47 attended the meeting and Ivo Babuška was the coordinator and host. Nineteen presentations were given. On Friday evening, November 11, the group enjoyed dinner and entertainment at the Burn Brae Dinner Theater where a performance of "Carousel" was given. Ivo's talk: A-posteriori estimates and adaptive meshes.

On November 17-18, 1978 the Circus met at the University of Texas: The book reads:

A bus trip to Coupland, Texas was organized by Tinsley Oden. In Coupland, we had a Texas barbecue in an old and famous establishment, after which we went to the Coupland Tavern and listened to some country-western music.

The first Circus poem was contributed in November, 1978.

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There once was a fellow named Dare,
Who approximated PDEs with great care.
But the solutions were rough
And the problems were tough,
So he only got O(h²).
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After Circuses at Maryland, Cornell, Michigan (Ridg Scott and Mitch Luskin were the hosts), Rutgers, and again at Maryland, the Circus returned to Texas and was hosted by Linda Hayes and Tinsley Oden. The Circus book has this entry:

Continuing the tradition of unique dining experiences (last time a Texas barbecue), the 31 participants enjoyed a dinner cruise on Friday evening. Continuing another tradition, Al Schatz, the last speaker, communicated results so recent that the proof of the main result was first discovered by Al during the last half of his talk.

On to Penn State (host: Bill Hager) and then back to Chicago. Jim Douglas was the acting "Ringmaster" since Ivo had the flu and could not attend. At this Circus, Craig Douglas gave a talk and so Jim had the distinction of being the first Circus member to have a son or daughter give a talk. Ivo was missed, as evidenced by the following Circus poem:

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We gathered in Chicago
To hear the progress that's been made,
To learn of the open problems,
And the new tricks of the finite element trade.

Though Jim was a great stand-in
And we had our usual rhyme.
It's not the same old Circus
Without Ivo keeping the time.
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In May of 1983, the Circus returned to Cornell. The Circus book lists the following entry.

The Finite Element Circus once again returned to the shores of Lake Cayuga for the spring, 1983 meeting. Besides a full schedule of 17 talks, Circus members enjoyed a busy social schedule with lunch at the Statler, an enjoyable cocktail party hosted by Jim and Peggy Bramble, and a fine dinner at L'Auberge.

On to Tennessee where Steve Serbin was the host and then back to Michigan where the Circus book reads:

Ingrid and Claes Johnson hosted, very graciously, a welcoming party on Thursday evening to put everyone in the right mood for the rigors of Friday when Ivo as usual cracked the whip in the morning.

In May, 1984, the Circus was back at Maryland where the entry is:

Only a masterful job of organization by Ivo Babŭska and his strict adherence to a tight schedule allowed us to get through all the talks, enjoy lunch at the Chinese Pagoda, dinner at Hogates restaurant, and attend a performance of Shakespeare's The Tempest at the Arena Theater.

In April 1985, the Circus were at Duke, where Craig Douglas had moved up from Circus member son to Circus host. In November, we were at Brookhaven (Joe Pasciak was the host) and the Circus poem tried to capture some of the local flavor (in fact the title of the poem was: ``Local Flavor'').

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When the Circus comes to Brookhaven,
All it members feel secure.
No mathematical spies can get by the guards.
Of that you can be sure.

There is one slight problem, though
And it concerns the breakfast cereal.
That unusual taste you raved about
Was honey coated nuclear material.
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Then Circuses at Rutgers, Tennessee, Brookhaven, and back to Cornell, where Manil Suri contributed the following poem.

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28 speakers at Cornell
12 minutes for each before the bell
If any of them longer should dwell
Ivo got up and gave them hell.
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In May of 1988, we were back at Maryland. The Circus book has the following entry.

The spring meeting was held at the University of Maryland, the spiritual home of the Finite Element Circus. Fifty Circus members attended with 26 giving talks. Ivo reminded us that there is no such thing as a free lunch. However, there was a free dinner, sponsored by the Math Department and held at Rossborough Inn. This building is of great historical significance, serving as a carriage house on the road from Baltimore to Washington during the 1700s. One new fact we learned about this period was that despite his many great accomplishments, George Washington was almost completely ignorant on the subject of finite elements. For example, George believed that any pair of velocity-pressure spaces for the Stokes problem would be stable.

On to Penn State and then Purdue (where Jim Douglas had moved). The Circus poem entitled "Your Time is Up" captured a key Circus feature.

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In the early years of the Circus,
The number of talks were few.
There was no inf-sup to guide us
And the h version was all we knew.

Since then we've made much progress
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But the basic principle is as before.
No matter how good your results are
You get 15 minutes and no more.
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In November of 1989, the Circus was at UMBC and the next one was at Cornell where we once again had dinner at L'Auberge.

In October of 1990, the Circus was at Rutgers. This was the 20th anniversary of the Circus, and Craig Douglas recalled a Circus years before when he, a teenager, performed the traditional ceremony of drawing names to determine the order of speakers. Unfortunately, Ivo could not attend. The following Circus poem sums up the Circus history to that point.

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Standard Galerkin, mixed, and least squares,
Raviart-Thomas, BDM, and PEERs.
Miscible displacement, Stokes, and plates,
L∞, negative norms, and optimal rates.
Direct, CG, multigrid, and ADI,
Inf-sup, bubbles, harmonic, and bi-,
h and p versions and combined h-p.
That's my twenty years Circus summary.
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After a Circus in Houston, we were at Penn State where the "Circus was dedicated to one of its foremost lion tamers, Bruce Kellogg, on the occasion of his sixtieth birthday."

Then some new locations; the Naval Academy, host: Sonia Garcia, and the University of Delaware, host: Peter Monk – a mathematical grandson of an original Circus member (Jim Bramble). In November 1993, we were back at Cornell. The Circus book reads:

Jim Bramble hosted a party at his home in honor of Al Schatz's 60th birthday. The food was so abundant and good that the usual Circus dinner was unnecessary.

After a Circus at Rutgers, we were back at Penn State. The Circus book has a new type of entry, called "Highlights of the Circus." This reads:

Doug Arnold, having won best transparencies 12 times in a row, did not enter this years contest, being too busy with his duties as Circus host. It is not clear who won, but it was certainly not Bruce Kellogg, who despite the high quality of his mathematical results, apparently hasn't figured out how to even make transparencies. There was some good news to report at the Circus. Al Schatz, who came to the Circus having lost a logarithm, found it again at Penn State.

The next Circus was at Brookhaven, where we learned that Ivo would be moving to the University of Texas. After Ivo moved to Texas, Doug Arnold and Rick Falk took over as co-organizers of the Circus (starting in 1995). Doug was replaced by Lars Wahlbin in 2003 and since 2012, Rick Falk and Sue Brenner (a mathematical granddaughter of Gil Strang) are co-organizers of the Circus.

Many of the entries in this history poke fun at the disciplined way that Ivo ran the Circus. But in fact, one of its attractions has been that people who have something to say know that if they come to a meeting, they will be given a fair opportunity to speak. It is also a place

where Circus members have been able to speak about work in progress and receive advice, without having to worry that their ideas will be unfairly used by someone else.

The Circus history described above is mainly concerned with the events themselves. However, a proper history needs to include some interpretation of these events. Certainly, the Circus played a key role in making the study of finite element methods into a major area of applied mathematics.

The Circus has also played an important role in the careers of many of its members. As graduate students and then as young faculty members, the Circus provided an opportunity for its junior members to immediately learn about the latest results in the field (instead of waiting two years to read about them in a journal), to present results before the leading researchers in the field, and to get to know the other Circus members on a personal level, and not just as names in a journal.

Much of the credit for the success of the Finite Element Circus belongs to Ivo Babŭska. He started the Circus, ran the meetings, and nurtured it over the years. Because of the success of the Circus, other groups have started similar meetings. Two prominent examples in finite elements are the Finite Element Rodeo and the European Finite Element Fair. In spring 2000, there was the first joint meeting of the Circus and the Rodeo at the University of Texas and in spring 2008 and spring 2013, there were joint meetings of the Circus and the Rodeo at LSU. In June, 2011, the three groups held a joint meeting in Paris. The number of participants in Circus meetings has grown steadily over the years, attesting to the interest in and impact of the finite element method. Sadly, there are a number of people who were frequent contributors to the Circus, who have passed away (Graham Carey, Dick Ewing, Bruce Kellogg, John Osborn, Steve Serbin, and Lars Wahlbin). While they may not be known by the new members of the Circus, their results certainly are.