

**Professor Jiri TLUSTY**



Professor Jiri Tlustý,  
born on January 5, 1921.

Professor Tlusty has been considered a worldwide legend in machine tool design research for the past half a century.

He was born in the former Czechoslovakia on January 5, 1921, and began his engineering career in the early 1940s. He founded and directed a world class machine tool research institute, the VUOSO, in Prague, where he started to publish on his well-known chatter theory in 1954. He was one of the first to model the relationship between the dynamic stiffness of the machine tool, the cutting force coefficient of the work material and chatter vibrations. Since then, he has contributed significantly to machine tool design, machine tool structures and vibrations, metal cutting, machine tool metrology, high speed machining dynamics, sensors for machine tools, chatter avoidance and suppression, precision machine tool design and CNC systems.

After leaving Prague in 1969, he spent two years at the University of Manchester, UMIST, where he directed research in Machine Tool Testing Standards. Prof. Tlusty then moved to McMaster University (Hamilton, Ontario, Canada), where he pioneered manufacturing engineering and research culture in Canada. He contributed significantly to the fundamentals of machine tool dynamics, chatter in milling, adaptive control, tool condition monitoring, modeling of metal cutting process, chatter in rolling, robotics, grinding and machine tool testing at McMaster University. He retired from McMaster in 1985 at the mandatory retirement age of 65. But Professor Tlusty was too young and energetic to actually retire, and in fact began a new academic career at the University of Florida, where he founded a Machine Tool Research Center. He focussed on the high speed machining, and contributed significantly to the acceptance of the technology in USA and worldwide. He designed and modeled high speed spindles, high speed feed drives, control systems and built a five axis high speed machining center for milling Aluminum alloys for aerospace industry, and a three axis high speed machining center for die and mold machining industry. In parallel to his academic activities, he formed Manufacturing Laboratory Incorporated to bring the technology to the industry, designing precision machine tools and applying his legendary engineering skills and methods to chatter problems experienced by various companies. He continues his career in his company as the most energetic and innovative engineer I have ever met in my life.

In addition to key articles in machine tool engineering, Professor Tlusty has also published the widely used classical reference book on *Structures of Machine Tools* (1971), and a comprehensive textbook titled *Manufacturing Processes and Equipment* (1999).

We, his former graduate students, have been mentored and trained in the fundamental principles of machine tool engineering by Prof. Tlusty. Professor Tlusty taught us to value industrial relevance, the simplification of complex machine tool problems to solve the most significant problem with the highest impact on productivity, and hard and accountable work.

Professor Tlusty's graduate students and colleagues have contributed their memories in this booklet. We wish Professor Tlusty and his beautiful and most warm-hearted wife Hana all the best in their new activities. We know that Prof. Tlusty will not and should not retire from the machine tool engineering which he always enjoyed, and to which he has contributed more than anyone in the past century.

Yusuf Altintas, Professor May 13, 2001  
University of British Columbia  
Vancouver, Canada

## **George Tlusty, Memories and Views**

My first memories of George (Jiri) Tlusty are from 1961 when I, together with my wife Helen, attended the CIRP General Assembly in Prague, of which George was the organizer. It was our first General Assembly and he made it one that we shall never forget. It was the beginning of a whole new world for us -- one of friendship and fellowship – and he made it a memorable occasion indeed.

First of all, as recorded in Helen's account of that event in the CIRP history, George made it a truly gala occasion. It included an evening at the opera – Smetana's "The Bartered Bride" in the baroque Smetana Opera House -- followed by an "Evening of Music" in which the different national delegations sang medleys of songs native to their own countries. Then an evening in Gottwaldov in which we were entertained by – and danced with -- folk dancers. And, as the crowning memorable event, the final gathering – a "Dinner in the Hunting Style" – on the terrace of a former nobleman's house, where all sorts of meats were roasted over an open fire and, to quote Helen's history of the event – "music and dancing reigned".

Secondly, George made it a most rewarding technological occasion. In addition, of course, to the well-organized and excellent technical program of the General Assembly itself, he organized half-day visits to the VUOSO Research Institute for Machine Tools and Metal Cutting Research in Prague, where George at that time headed the Machine Tool Research Division, and to the ZPS Machine Tool Plant in Gottwaldov. These gave me an excellent insight into not only the admirable status of Czechoslovakian machine tool research and engineering but also, and more importantly, into the nature and excellence of George's research in this field. In that early research he was concentrating on enabling the Czech machine tool industry to achieve world-class capability in the field of machine tool engineering, and particularly in the emerging technology of numerical control of machine tools, and I could see that he was well on his way to accomplishing that. To quote from the report that I made when I returned from that trip, "in many areas Czech machine tool technology is already on a par with that of the USA".

George's early and pioneering research, development and application of the emerging technology of numerical control of machine tools went on to enable the Czechoslovakian machine tool industry to become the front-runner in this new field in Eastern Europe, with the rest of the Eastern European countries following in its footsteps. His continuing research and development of leading-edge machine tool technology throughout his distinguished international research career has been equally beneficial to the world machine tool and manufacturing industry. For example, his ground-breaking research, development and application of the technology of machine tool chatter and vibration provided, for the first time, methodology that was both fundamentally sound and readily applicable to the engineering of machine tool dynamics – and one that has become the approach most often used in machine tool design and application today.

Since the days of that first CIRP experience that I described above, I have never ceased being deeply impressed by the quality and fundamental significance to industry of George Tlusty's research contributions!

**M Eugene Merchant, Senior Consultant, TechSolve**

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*A World Leader in Manufacturing Technologies*

February 27, 2001

Prof. Jiri Tlustý  
University of Florida  
Mechanical Engineering Dept.  
Gainesville, FL 32611

Dear George:

Congratulations on beginning the retirement phase of your career. You can look back with pride on your many accomplishments and the well-deserved recognition you received from your peers.

When you brought your talents to North America, we in the Machine Tool field were delighted to be joined by a Professor with outstanding academic skills as well as great practical experience. From the beginning it was clear that industry would benefit. You solved difficult technical problems for the manufacturing community and the Machine Tool industry. You also developed some strong new Professors who have extended your teachings and discipline to benefit other universities and throughout industry.

You taught the technology of high speed milling and best practices to Cincinnati Milacron engineers from the fields of cutting tools, cutting fluids and machine tools. Whenever we brought you a problem you listened and were always able to help.

I have enjoyed working with you because of your perceptive analysis of problems, your excellent technical advice, your patient explanations and your sharp sense of humor. It has been a pleasure for me and profitable for my company.

Milacron and I wish many years of happy retirement to you and your charming wife.

Very truly yours

A handwritten signature in blue ink that reads "Dick Kegg".

Richard L. Kegg  
Vice President Technology and Manufacturing  
Development (retired)

My first encounter with George Tlusty was about 1957-58. I was a beginner PhD student ("aspirant") of Prof. D.N. Reshetov at ENIMS (Experimental Research Institute for Machine Tools) in Moscow. Tlusty was invited from our sister Institute VUOSO in Prague (Czechoslovakia was still part of the Soviet Empire) to talk about his recent chatter theory. ENIMS was about 1,500 - 2,000 strong at that time; the conference room was filled with at least 200 listeners. It was expected that George would speak in German or English. Our young and beautiful interpreters Zoya (from German) and Nadia (from English) were ready and eager to translate this for handsome, dynamic guy (George, do you remember them?). After the introduction, Tlusty comes to the podium, takes off his pullover sweater, as if preparing for hard work, and starts: "I routinely read Russian technical literature, but I never spoke Russian. Today I want to do it." And he did; a 40 min - one hour presentation, in understandable Russian.

**Eugene Rivin, Professor**  
Wayne State University, Detroit, USA.

I became acquainted with Prof. Tlusty 35 years ago, when I was working as a Ph.D.-student for and with Prof. Pahlitzsch, who presented parts of my scientific work to his colleagues within CIRP. Prof. Tlusty, who was known to me from his research work in machine tool vibration, took a critical look and made comments which showed his professional competency. In 1971 I myself became a CIRP member and had many contacts within the assemblies and working groups of CIRP with Prof. Tlusty during the years. I always appreciated his views which offered a new side and unconventional ideas. Prof. Tlusty is a world-known personality in the scientific community of machine tools and manufacturing. After an outstanding professional life, my best wishes for his private and personal future.

**Hans-Jürgen Warnecke, Professor,**  
Fraunhofer-Gesellschaft zur Förderung der angewandten Wissenschaften, München, Germany.

Memory goes back to August 1966 when I was visiting Europe for the first time to attend the General Assembly of CIRP in Geneva. Jiri Tlusty was the chairman of the Machine Tool session in which my first chatter paper was presented. Due to the limited time available, the main points of a number of papers were summarized by the chairman, and not by the authors. The chairman, Tlusty, introduced my paper to the audience as a reproduction of a study conducted by Dr. Jack Lemon in Ohio, which could not be publicized, however, because it was funded by the US Air Force. Listening to the brief summary that followed, I was impressed by the chairman's ability to assess instantly the essence of the paper.

Recently, in November 2000, I met Tlusty at an ASME congress held in Florida. Smiling at me, he said "You are still alive!" In the Manufacturing Engineering session of the congress, there were a number of papers discussing chatter. I noticed that many of the audience members in the room understood the chatter theory, for instance regeneration. Such situation rarely occur at conferences in other countries, including Japan. I have witnessed that Tlusty's teaching over several decades has been well learned in North America.

**Jack Hoshi, Professor,**  
Toyohashi University of Technology (TUT)  
Member Emeritus of CIRP  
[hoshi@cherry.tutse.tut.ac.jp](mailto:hoshi@cherry.tutse.tut.ac.jp)

I first became aware of Prof. Tlusty as the person who asked tough questions of people delivering conference papers. If you hadn't done all your homework, he would be sure to question you about the lesson you had skipped! Later, after many conversations with him (I generally tried to keep the topics non-technical), I came to know him as a truly likable man of the world. I wish him a wonderful retirement -- although I can't believe he's really doing it!

**Dr. Richard P. Lindsay, USA**

Professor Tlusty has been known to me since the CIRP General Assembly in Berlin in 1990. Our contact is sporadic. He is an unusual character – a real character - who has the effect of raising scientific standards as a result of his detailed (and sometimes aggressive) questioning of fundamental and applied issues. He is without

doubt a first class leader in his field of manufacturing research. I congratulate him on his success and wish him health and happiness.

**Gerry Byrne,**  
Professor and Head, Department of Mechanical Engineering,  
University College, Dublin, Ireland.

I wish you a long and happy retirement and thank you for your lively and stimulating contributions to the meetings of CIRP and your personal interest that has meant so much to so many of us.

Best wishes,  
**J.A. McGeough, Chairman CIRP UK**

I first heard of George Tlustý almost forty years ago when my colleague at the University of Salford had obtained George's book on Machine Tool Vibrations and was seeking someone to translate it into English. Later, through CIRP and the SME, I have had the privilege to know George personally and I admire him as much as anyone I know in the field of manufacturing research. He is truly an outstanding scientist who never hesitates to share his knowledge and his views. As we all know, any meeting or presentation is made more interesting by his presence!

I wish George a long and happy retirement, he certainly deserves it.

**Professor Geoffrey Boothroyd**

I first met Professor Tlusty "professionally" when I came to Berkeley in 1977. He was a visiting Professor in the Mechanical Engineering Department for the year and I sat in on his graduate class on machine tool design and control. Much of the material he covered eventually became part of his great textbook, now in print. I was delighted to be able to listen to a true master of the material and was impressed with his dedication to teaching and the students.... especially with the exercises he developed on controller performance and dynamics. As a result of that, I was really pleased to be able to get to know Jiri (or George) more and have the chance to discuss various aspects of manufacturing engineering with him.

I say that I first met him professionally in Berkeley because that was not my first "encounter" with him! As a graduate student in Madison, I was pressed in to service at the second NAMRC conference held there. As grad students we were privileged to mingle with the "glitterati" of the manufacturing research community...but not to have to confront them technically. I specially remember Professor Tlusty giving someone's paper in his place (for some reason this person had committed the cardinal sin of not appearing to present it himself). George presented it well but took issue with a number of the author's statements and had a wonderful time "re-interpreting" the paper...to the delight of the audience and the graduate students.

Later, as I worked my way up the career ladder, George was very helpful to me in other evaluations of my work. Although he disagreed with people on occasion, he was always ready to state his ideas and insight, and most often his comments were right on the mark. I think he is one of a few who would confront incorrect work when he noticed it and point it out. Alternatively, if he saw work he was impressed by, he was also quick to compliment it. He makes technical meetings lively and fruitful and it would be great if there were more like him willing to engage authors at conferences on their work. We all benefit from this...even when we are the authors in the bull's eye.

This celebration of his retirement and acknowledgement of a full career of outstanding contributions to machine tool engineering only marks another milestone in his career. I do not expect his contributions to end here. George, best wishes for a successful "retirement", congratulations on a wonderful career and I look forward to many more years of your enthusiastic and innovative engineering research!

It has been a pleasure to know you all this time. I am always pleased to be able to say "I know George Tlusty" whenever asked!

**David Dornfeld**

Will C. Hall Family Professor of Engineering  
Department of Mechanical Engineering  
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**Marvin F. DeVries**  
Professor

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Spring, 2001

Dear George:

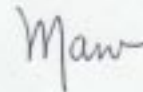
As you approach retirement, I would like to add a short note to the many others you will be receiving on this occasion. As I look back on our association, I clearly remember that it was you and our colleague, John Bollinger, who introduced me to the CIRP community. It was at the 1974 General Assembly in Tokyo and Kyoto, Japan. You and John and I were the three "bachelors" who were in the group of US Active Members and spouses who traveled as a group to this meeting. That was my very first trip outside of North America and, to say the least, it was a real eye-opener.

There is no possibility for me to summarize all of the times that we have interacted in various ways often in interesting venues. Just a few stand out, however. I recall the time you invited Bill Rice (representing CSME) and I (representing ASME - Production Engineering Division) to McMaster University to discuss the holding of a "CIRP" like conference of the metal cutting research community. George, your vision led to NAMRC, now NAMRI/SME, the 29<sup>th</sup> of which is being held this year at your university in your honor. I also recall the support you gave John Bollinger and I to hold NAMRC - II in Madison the year following. The accompanying photo of you, Milton Shaw and I was taken on that occasion. Two years later I still hadn't gotten a hair cut, but I did wear a more conservative sport coat as evidenced in the photo of us taken at the time of NAMRC - IV in Columbus, Ohio. And, once again you are seen in your normal happy mood.

Ten years later, NAMRC - XI, now affiliated with NAMRI/SME, was again held in Madison and some photographer took an "audience shot" capturing you in a very attentive and serious pose seated next to Bob Hahn, another pioneer in machining theory and practice. The final enclosed photo was taken another decade later in May, 1993 at the Symposium on US Contributions to Machining & Grinding Research in the 20<sup>th</sup> Century held at Oklahoma State University. While the majority of us in the photo are looking at the camera, you, most appropriately, have eyes on a most beautiful woman.

Martha would have, no doubt, her own series of stories to tell of our relationship including the time the four of us met for dinner in the Frankfurt airport and you were correcting Hanna on her spoken English which, in Martha's opinion, was better than yours! Anyway, Martha joins me in wishing you a long and happy retirement. We look forward to seeing you again, perhaps this year at the CIRP General Assembly in Nancy.

Sincerely,



Enclosures



My Dear Colleague, Jiri:

As the decades keep rapidly going by, we all live with the many memories of our days and years together. Though they are now beginning to fade, we do remember the countless meetings we have had, the discussions and the arguments, and the committee deliberations, with the voices of our many colleagues in all kinds of accents, sometimes soft, sometimes loud, and sometimes harsh. We do remember well the beers and the wines, in this land and in many lands; the banquets and the after-dinner speeches – some of which excited us and made us think and laugh, while others put us to sleep.

You are a colleague who, as a man of principle and much experience, always spoke his mind and freely expressed his many thoughts and observations, whether or not others agreed. With a peripatetic existence, you worked hard and diligently, and you were always at the cutting edge of our ever-widening field. You contributed so much to our honorable profession and for so long, with intelligence and focus and with ultimate goals that were truly responsive to the real needs of our industries.

Your presence was always felt in any gathering, of the young and of the old. Though it took some effort to do so, even if you chose to remain silent, your whimsical smile, the look in your eyes and the nod of your head said it all. At times the young were awed by your presence, while the old just smiled, as we have been doing ever since we were fortunate to have met you. You charmed us, you challenged us and, yes, at times you tested our patience – but all was well when we loosened our ties and raised our glasses to the success and happiness of our colleagues, especially the young among us.

Somehow, you constantly reminded us of an old Frank Sinatra song: *I Did it My Way*. And we are glad you did it your way, Jiri, because you are indeed unique.

May the years ahead be kind to you and to Hanna, and with your vibrant presence and your inquisitive mind, may you continue to challenge us and enlighten us. Many of us remember well when you were once a nimble dancer; may you continue to be so for a long time to come.

Happy 80<sup>th</sup> Birthday, Jiri.

Serope Kalpakjian

## **Jiri Tlustý at the Origin of the Machine Tools Stability Theory and Practice.** by Prof J.Peters, KU Leuven (Belgium)

Not everyone has had the privilege of enjoying a sunny afternoon in June 1968, chatting with Jiri Tlustý on the terrace of the Praha Restaurant, overlooking the Moldau river and the Karlova bridge. Everything was quiet on this blessed day of the 'Prague Spring'. Jiri was optimistic as always: "They will never return," he said. Unfortunately the Soviet tanks came back within a month! We made plans, but we never imagined that thirty three years later he would be enjoying Florida's spring, celebrating his eightieth birthday, surrounded by all his friends from around the world. With a glass of Urquell Pilsner before us we discussed Machine Tool Chatter. Remember: "Inspiration lies in the Glass and Lubrication is what makes machine work!"

We first met at Prof F. Eisele's FOKOMA Conference, where Tlustý as well as S.A Tobias had been invited to present their chatter theory. At that time Georges (the French translation of Jiri) was a member of the Czech Institute of Machine Tool Research and Design, called VUOSO. He headed a prestigious group of scientists: O. Danec, M. Polacek, L. Spacek, and later J. Zeleny, all machine tool designers and vibration people. They cooperated in writing the remarkable book on self-excited vibrations in machine tools, first in the Czech language (1954), and then in Russian translation (1956). The German edition, published six years later in 1962, drew the attention of the western technical world.<sup>1</sup> M. Polacek's major contributions were included in the German edition. The group originally found that the chatter, as self-excited vibration, depended upon the orientation of the cutting force vs. the direction of the main vibration modes of the machine. This was totally new at a time when the dynamic behavior of a machine tool was totally unknown. Inspired by his practical experience in MT design, J. Tlustý developed the theory starting with the theoretical analysis of a vibration system with two degrees of freedom. These studies are significant and represent a major step in the practical dynamical analysis of a machine tool, at a time where the instrumentation was very primitive and reduced to electrodynamic exciters and simple vibrometers and accelerometers. The dynamic response curve had to be taken by hand, point by point, and orientation by orientation. It took several days of work.

At approximately the same period the late professor F. Eisele of the TU München was studying the dynamics of single structures, such as beams and columns. He organized the FOKOMA Conferences in München, at the time one of the major events in European production engineering and machine tool design.

At the third (1959) and fourth FOKOMA (1960) Tlustý's opponent, Prof S .A. Tobias, appeared. Born in Hungary, Tobias had migrated to the U.K. He started research in Cambridge and later became head of the Mechanical Engineering Department at Birmingham University, where he also organized periodically a conference on Machine Tool Design and research called MATADOR. He appeared in München with his theory of 'Stability Lobes', which he had deduced on the basis of the theoretical analysis of a non linear first order system. The discussions between him and Tlustý were very lively! Tlustý could not accept that a first order system could ever become unstable. Tobias could not understand Tlustý's point of view. In the introduction of the German edition of his book (1961), and in the subsequent English version, Tobias states: "Other publications of J. Tlustý and M. Polacek are not dealt with in this book. The reason for that is that, in so far as simple machine tool systems are concerned the method developed by Tlustý and Polacek yields a less accurate picture of the dynamic behaviour of the machine than the method discussed in this book." Tobias further claimed that the Tlustý-Polacek method runs into difficulties, when applied to complex machine tool systems<sup>2</sup>. Obviously the reason for this discrepancy is that Tobias performed his experiments only on a small laboratory milling machine, while the VUOSO team worked in the machine tool industry on industrial prototypes.

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<sup>1</sup> O. Danec M. Polacek, L. Spacek, J.Tlustý, 1962, Selbsterregte Schwingungen an Werkzeugmaschinen, VEB Verlag Technik Berlin.

<sup>2</sup> Tobias, .S.A. ; 1961 Schwingungen an Werkzeugmaschinen, Carl Hanser Verlag, München

In the initial phase Tobias did not give evidence of his theory on lathes. In order to clear up the problem P. Vanherck showed the 'loops' on a lathe, provided the natural frequency was lowered adding a mass on the tool holder-bar. However the real proof of the complementarity of both theories was shown at Leuven University, when the stability chart of the machine was experimentally made by exciting the machine tool in the direction of the cutting force and the vibration detected in the direction perpendicular to the transient surface. This was presented in a seminar at the TH Aachen, and published in *Industrie Anzeiger* in 1963.<sup>3</sup>

It took some time before the complementarity of both theories was admitted. In 1962, J. Peters and J. Tlustý were invited to give a presentation at the General Assembly of CIRP in The Hague. This was the origin of CIRP's Scientific and Technical Committee on Machine Tools in CIRP, which devoted considerable activity to the study of the dynamic behavior of machine tools and to the various damping techniques, such as passive vibration absorbers (damped boring bars and milling machine arms); fluid damping and active damping. This work is reported in the *Annals of CIRP*, Working Group Ma, from 1963 to 1970.

Let us however return to the turbulent career of J. Tlustý, who spent very fruitful months at U.M.I.S.T in Manchester, where he worked with another machine tool specialist, F. Koenigsberger, and his group. In 1970 a Conference on the Dynamic behavior of Machine Tools was organized in Manchester where Tlustý played a major role. A leading publication emerged: "Specifications and Tests of Machine Tools"<sup>4</sup>, which introduced dynamic tests at a time when Schlesinger's and Salmon's and related ISO standards only prescribed static tests.

Again in this standardization work, two tendencies were opposed. The first propagated tests, based on the 'limiting depth of cut' in all possible situations, which were practical but tedious. The second based its criteria on the measured stability contours, and was further developed by M. Weck and K. Teipel of T.H.Aachen. The computer had been invented! Computer programs were made to define the directional stability of MT based upon the measurement of the direct and the cross compliance of the dynamic response.<sup>5</sup>

Let us now warmly congratulate our friend Jiri for his constancy and lifelong effort to keep faith amid the various troubles he faced during his career. Jiri Tlustý is a genius, as an innovator and as a designer of machine tools. He turned theory into practice. He developed and kept an original vision of M.T stability on the right place in the design, while many of today's researchers are subjugated by the numerical simulation or the modeling techniques and forget that a machine tool should firstly be designed to make real, not virtual chips.

Jiri reminds us that the "The proof of the pudding is in the eating!"

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<sup>3</sup> J. Peters, P. Vanherck, 1963, Ein Kriterium für die Dynamische Stabilität von Werkzeugmaschinen, *Industrie Anzeiger* N° 11 and 19.

<sup>4</sup> UMIST, Specifications and Tests on Metal Cutting Machine Tools Proceeding of the Conference, 19-20 Februari 1970., Manchester.

<sup>5</sup> Weck M., Teipel, K., 1977, Dynamisches Verhalten Spanender Werkzeugmaschinen, Einflüsgrößen, beurteilungsverfahren; Springer Verlag Berlin

## *Toshimichi Moriwaki, D.Sc. Kyoto University, 1974*

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### **McMaster Years**

**Position:** Research (1974) and later Assistant Professor (1975).

**Research Topics:** Dynamics of machine tools, Vibration analysis of turbo generators, Dynamic cutting force coefficients

**Machines Used by Moriwaki:** MAZAK Conventional Lathe, Excello Type 602 ram turret milling machine, Turbo Generators at Lakeview Generating Station.

**Instrumentation Used:** HP Fourier Analyzer

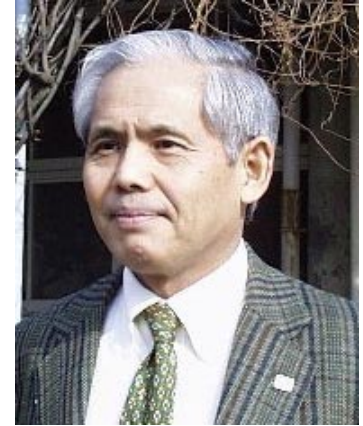
**Laboratory Colleagues:** Dr. G. F. Mutch (Research engineer), Dr. M. Yunis (Research engineer), B. S. Goel (Ph.D. student), M. A. Elbestawi (Master student)

**Research Life under Prof. Tlusty:** Hard work, but quite educational, challenging, and rewarding.

**Personal Remarks – Experience:** I was the first Japanese engineer who worked with (under) Dr. Tlusty at McMaster as a Post Doc. engineer. I learned a great deal about how to work, and a good deal about how to enjoy life. I also enjoyed tough discussions with Dr. Tlusty.

### **Present Status**

Professor, Member of CIRP, ASME, JSME, JSPE, ASPE, euspen etc. Laboratory for Computer Integrated Manufacturing, Department of Mechanical Engineering, Kobe University, Rokko, Nada, Kobe, Japan (E-mail; [moriwaki@kobe-u.ac.jp](mailto:moriwaki@kobe-u.ac.jp))



**Prof. Moriwaki with his students at Kobe University, Japan., 2001.**

**Mo Elbestawi, M.Eng & Ph.D.,**  
**McMaster University, 1974-79**

**Thesis Topics**

**M.Eng:** Analysis of a Numerical & Adaptive Control  
Servomechanism

**Ph.D.:** A Study of an Adaptive Control Constraint System for Milling



**Machine Tool Used:** Retrofitted TOS Vertical Milling Machine

**Instrumentation :**

- HP 2100A mini computer / Fourier Analyzer
- In-house built strain gage, rotating dynamometer
- In - house built table dynamometer (piezo electric transducers)
- Vibration sensors (accelerometers and displacement probes)
- Software developed in Fortran for simulation studies and Assembler for real - time control of the TOS.

**Laboratory Colleagues:** Zaher Masood (M.Eng), Samir Shalaby (M.Eng), Sayed Orady (Ph.D.), B.S. Goel (Ph.D), S. Rao (M.Eng), Gordon Mutch (Ph.D), T. Moriwaki (Research Associate), J.H. Dautzenberg (Research Associate), M. Younis (Research Associate), Oskar Heczko (M.Eng).

**Graduate Student Life Under Professor Tlusty:** VERY hard work, responsibility and accountability, "think hard before you open your mouth! ", big picture, industrial relevance, pride, discipline, best education experience and training for professional career, character building...

**Present status:** Professor and Director, McMaster Manufacturing Research Institute (MMRI); Fellow ASME, Fellow CSME, Member CIRP, Senior member SME McMaster University , Hamilton, Ontario, Canada L8S 4L7.

***Elsayed Aly Orady, Ph.D. McMaster University, 1976-1982***  
***McMaster Days***

**Thesis Topic:** "Thermal Cycling in Intermittent Cutting Processes," (1977 - 1980), defended September 1982.

**Machines and Instruments Used by Orady:** Vertical Milling Machines, Tool Makers Microscope, Tool grinding machines.

**Software Developed by Orady:** Finite element package for thermal analysis of intermittent cutting processes, and finite element mesh generator for metal cutting zones.

**Laboratory Colleagues:** Fathi Ismail, Mohamed Elbestawi, S. Rao, Samir Shalaby, B.S. Goel, Gordon Mutch, M. Younis, Oskar Heczko.

**Graduate Student Life under Prof. Tlusty:** Hard work, good learning experience, be skeptical do not trust what is written in papers before verifying, challenging, always seek more knowledge, emotional, never travel with him in his car.

**Personal Remarks – Experience:** Dr. Tlusty is the most knowledgeable person on earth in his field of expertise, namely; machine tools, the most intelligent person I ever met, the most emotional and the toughest.

**Present Status:** Professor and Coordinator of the Manufacturing Engineering Program, Industrial & Manufacturing systems Engineering Department, The University of Michigan - Dearborn, 4901 Evergreen Rd. Dearborn, MI 48128  
Member of IIE, SME, and ASME, AMSE and President of the Association of Muslim Scientists and Engineers (<http://www.amse.net>)

e-mail: [orady@umich.edu](mailto:orady@umich.edu); <http://www.engin.umd.umich.edu/~orady>

## ***Fathy Ismail, McMaster University, 1976-1983***

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**Ph.D.** “ Identification, Modeling and Modification of Mechanical Structures from Modal Analysis Testing”

**Research Associate:** 1980-1983.

**Machines Used:** MAZAK lathe, TOS, Bostmatic and Excello milling machines.

**Instrumentation:** Modal analysis equipment (HP 5423 analyzer, impact hammers, accelerometers, capacitance proximity probes.etc), HP laser interferometer set up for machine tool metrology, home built table dynamometer, UV chart recorder!



**Laboratory Colleagues:** Dr. W. Zaton, Dr. M. Younis, Dr. Moriwaki, Dr. N. Okobo (research associates and visiting professors). Z. Masoud, S. Shalaby, S. Rao, O. Hezho, R. Rafouli, T. Jones, P. Young (M.Eng.), M. Elbestawi, E. Orady (Ph.D).

**Personal Remarks:** I worked with Prof. Tlusty for 6 1/2 years, as a Ph.D student and as a research associate. I went with him to Aachen, Germany during his sabbatical in 1978. Also, I participated with him in numerous consultations in Canada and the United States. I spent with him long ..long...long hours on those consultations. *I remember Prof. Tlusty's favorite phrase: “You probably know nothing”. He said it to students, support staff, and, yes, to other professors.* He did not tolerate mediocrity, and expected, and demanded everyone around him to work hard and to act professionally. Those who did not...really got it. *Probably because they knew nothing.*

**Present Status:** *Professor* and associate chair for graduate studies, Department of Mechanical Engineering, University of Waterloo, Waterloo, Ontario, Canada, N2L 3G1.

## *Trevor Jones – McMaster Years*

As a young engineer, a recent graduate, and a new employee working for Dr. Tlusty, I can recall one trip in 1981 while performing some consulting work for Stake Technologies. At that time, the company had a machine for treating biomass material that was breaking down. They called in the machine expert - Tlusty - and I accompanied him.

The trip to the airport was eventful in itself. As Dr Tlusty was briefing me about our assignment, he was also driving along the QEW. Normally, this is not a problem, except that the technical puzzle at hand was obviously consuming the greater share of his attention. Consequently, we were taking up two lanes of the road (the fast lane being one of them), and we were travelling at approximately 50% of the rated speed of the roadway. Somehow, we reached the airport without injury. Everything went well from that point until the airplane touched down at our destination. No sooner had the main landing gear made contact with the runway, than Dr Tlusty promptly got out of his seat and began unloading his bag from the overhead compartment. I estimate that the plane was still travelling at about 200 kph along the runway at the time. It took several panicked cabin stewards the remainder of the landing roll to convince Dr Tlusty to remain in his seat until the plane arrived at the gate.

The remainder of the trip was rewarding. We witnessed the machine in operation, and with careful deliberation determined the cause of the problems. Subsequent work gave me an opportunity to work with Tlusty at his private company – MANRAD - where I and a close colleague designed a replacement machine with many interesting capabilities and attributes.

That trip taught me several things, to which I remain faithful to this day:

1. Never travel with Dr. Tlusty, and,
2. In order to be #1 in your field, you must have a dedicated concentration to your art.

I was taught by Dr Tlusty for one year at McMaster, and later worked closely with him for 2 1/2 more. In that time and ever since, I have never seen an equivalent talent who understood his craft so well, dedicated himself to understanding the field with such a level of detail, and did so with such single-minded purpose. I like to think I worked well with Tlusty. We both understood that the search for knowledge was the driving principle behind our work. With that common understanding, I believe we both achieved a lot during our short time together. Many of the attributes I consider a part of my success in my professional life stem from the lessons I learned from Dr Tlusty. I am forever grateful.

Trevor Jones, P. Eng.  
Chief Technical Officer, CRS Robotics Corp  
tjones@crsrobotics.com 1-800-365-7587 (x244)



## Wieslaw Zaton - McMaster University, 1981-84

In the early Fall of 1980 the Institute of Manufacturing Technology of the Technical University of Wroclaw in Poland was abuzz: "Tlusty is coming". An icon to every engineer who had anything to do with metal cutting was to visit the Institute, where I had worked as an assistant professor.

The entire faculty and many students listened to the lecture of the distinguished guest, who delivered his speech in fluent Russian, the preferred foreign language of his audience. Dr. Tlusty spoke of his research at the McMaster University in Hamilton, Canada, and later offered one of my friends a one-year post-doctoral stay at his research facility at McMaster. As it turned out, although the prospective post-doc spoke English well, his research interest was not what Dr. Tlusty had anticipated, and I was invited to talk to the Big Man. Since I did not speak English the conversation took place in Russian. Once it was established that I might be a suitable substitute for my friend, I was asked: "And what are your linguistic talents?" "Ordinary, I'd say", was my answer. Apparently that was enough.

It took me six months to wrap up the projects I was working on in Wroclaw. In May of 1981 I entered Dr Tlusty's McMaster's office and greeted him. In Russian! It was the first time I was declared innocent.

A few days afterwards Dr. Tlusty went to Europe for two months, leaving me to work closely with one of his new foreign students. The fellow had just come from India to work on his Masters degree under Dr. Tlusty's tutelage. We labored hard writing software for the identification of parameters of ARMA models. At first our preferred language of communication was Fortran. With time, though, we slowly switched to English. When our boss came back from Europe he saluted me with: "Oh, your English has improved quite a bit, but why do you speak with an Indian accent?"

A couple of months into my stay at McMaster Dr. Tlusty's group organized a NAMRC conference. Many visitors were given a tour of the Metal Cutting Lab, and I witnessed the linguistic prowess of my host as he switched effortlessly from English to German to French to Italian. I'm not sure about the Italian – it was so many years ago. Observing my discomfort with my beginner's English Dr. Tlusty offered a consolation: He, too, had to deal with occasional questions or remarks in response to his English. They were of the "What a charming accent" variety, sometimes a "Where are you from?" as well. At the end of my first year at McMaster I faced the possibility of returning to Poland, which was under martial law at the time. Dr. Tlusty suggested that I extend my stay. To do it officially I had to obtain permission from my workplace in Poland, so I cooked up a pacifying letter saying that the longer I resided at McMaster the more tricks I could learn that could be used in the Polish machine tool industry. I wrote it in Polish using block letters, and then Dr. Tlusty's secretary typed it. It took her almost a day to type those two paragraphs correctly. To appreciate the difficulty of her task, I ask the reader to read and pronounce the popular Polish phrase: "Chrzaszcz brzmi w trzcine". Immediately afterwards I found one of those ubiquitous "Come and see me. J.T." notices on my desk. On entering Dr. Tlusty's office I was pronounced innocent yet again. Having been found innocent numerous times in the previous year, I had developed sufficient immunity and was able to face what followed stoically. I was told that I had signed a nondisclosure agreement and should be very careful about what I was going to use in Poland. The remark was obviously right. What shook me though was that the man could understand *Polish* as well!

Two more years at McMaster followed, until Dr. Tlusty left. I have fond memories of bright and inspired young engineers I worked with, under Dr Tlusty's guidance: Yusuf Altintas, Fathy Ismail, Trevor Jones, Rod Rafauli, Takashi Yamada, Peter Young, and others. My family eventually left Poland, joined me in Hamilton and became established in Canada. When we discuss our beginnings in this country, Dr. Tlusty's name is often mentioned. Thank you Dr. Tlusty. Thank you for giving me the opportunity to learn English and thank you for so much more.

## ***Yusuf Altintas, Ph.D., McMaster Years***

**Ph.D. Thesis Topic:** “Tool Condition Monitoring for Unmanned Machine Tools.” (1983-1986), defended in March 1987.

**Machines Used by Altintas:** MAZAK Conventional Lathe, TOS Vertical Milling Machine Retrofitted with an in-house developed CNC at McMaster. LSI-11/34 16 Bit Minicomputer with an 8 channel Data Acquisition Card., Acoustic Emission Sensor, HP Fourier Analyzer, in house built semi-conductor strain gage table dynamometer, quick stop. Programs were written in Fortran and LSI-11 Assembler.

**Laboratory Colleagues:** Dr. W. Zaton (Postdoctor, Machine Tool Vibrations), Robert Laflamme (M.A.Sc.), Thomas Chan (M.Sc.), Dave Harbourn (M.A.Sc.) and Rod Rafauli, Trevor Jones, Peter Young (Research Engineers).

**Graduate Student Life under Prof. Tlusty:** Tough (!), educational, hard work, best engineering training, most challenging, disciplined, rewarding, accountable, practical, interdisciplinary research, industrial relevance, machine tool engineering. Dr. Tlusty was the best (and toughest) teacher I have ever had. My research and engineering career have been most much influenced by Prof. Tlusty.

**Personal Remarks – Experience:** I studied under Prof. Tlusty for a short period (June 1983-January 1984, May 1985-July 1985) at the Machine Tool Boot Camp (MTBC) at McMaster. However, I made up the lost years when I spent my sabbatical year at the Machine Tool Research Center at UF (September 1999-July 2000). We had stimulating debates on chatter vibrations and feed drive control, and I learned immensely about machine tool engineering, testing and dynamics from Prof. Tlusty. I enjoyed being a “senior student” at MTRC while carrying a full professor title.

**Present Status:** Professor, ASME Fellow, Active CIRP Member. Married with two children, Manufacturing Automation Laboratory, Department of Mechanical Engineering, University of British Columbia, Vancouver, B.C. V6T 1Z4 CANADA, <http://www.mech.ubc.ca/~mal>



**Prof. Altintas with his graduate students at UBC. (1997).**

## **Scott Smith, M.S. 1985 Ph.D. 1988 University of Florida**

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### **University of Florida Years**

**Thesis Topic:** “Chatter, Forced Vibrations, and Accuracy in High-Speed Milling” (1983-1985), defended in 1985.

**Dissertation topic:** “Automatic Selection of Optimum Spindle Speeds in High-Speed Milling” (1985-7), defended in 1987. Colleague of Dr. Tlusty at the University of Florida 1988 – 1997.

**Machines used by Smith:** Lamb Milling Machine (fitted with spindles from Pope, Valeron, Magnetic Bearings, Inc., and Setco, controllers from GE and Fanuc). Sundstrand Series 20 Omnimil (OEM controller and one from Automation Intelligence). Mazak Quick-Turn Lathe, and a University of Florida-built High Speed Machine (36,000 rpm 36kW spindle, 2g acceleration, Delta-Tau Controller).



**Instrumentation used:** MLI MetalMax system and Harmonizer. MILSIM, TXF and SPA software. Gen-Rad 8 channel Fourier Analyzer, and HP 25660A Fourier Analyzer. UF-built piezoelectric table dynamometer.

**Laboratory Colleagues:** E. Stern, I Hernandez, C. Zamudio, T. Delio, B. Cobb, D. Wegerif, W.R. Winfough, R. Wells, J. Frost

**Graduate Student Life under Prof. Tlusty:** Definitely the most valuable time in my engineering career. Prof. Tlusty placed a strong emphasis on the practical significance of research work. There were many long hours and late nights (but Prof. Tlusty was there as well!).

**Personal Remarks – Experience:** I don't think that there is anyone who enjoys his work more than Prof. Tlusty does. He is a visionary, and his impact on the machine tool industry has been (and continues to be) truly remarkable. I owe a large part of who I am to his influence, guidance, and friendship.

### **Present Status**

Professor, US CIRP Corresponding Member, ASME Member, NAMRI Member.

Married with two children.

Department of Mechanical Engineering,  
University of North Carolina at Charlotte  
Charlotte, NC 28223

***Thomas S. Delio, Ph.D. University of Florida, 1986-1989***  
**University of Florida Years**

**Thesis Topic:** "A Sensor-Based Adaptive Control Constraint System For Automatic Spindle Speed Regulation To Obtain Highly Stable Milling" (1986-1989), defended in December 1989.

**Machines Used by Delio:** Sundstrand Omni-mil and McMaster Testbed machine with numerous spindles (magnetic bearings spindle, Pope, Valeron, SETCO Phase 1-2) using GE Fanuc control.

**Instrumentation Used:** HP and B&K analyzers, various in-house gages and transducers. MLI analyzers, MTDA, MLA and MetalMAX.

**Laboratory Colleagues:** Dr. S. Smith (Asst. Professor, Machine Tool Vibrations), David Smith, Bob Winfough, Britt Cobb, Carlos Zamudio among others (all students in the UF MTRC during some part of tenure).

**Graduate Student Life under Prof. Tlusty:** Not bad except when the machines refused to work past 9:00 PM at night (it definitely wasn't the students' fault).

**Personal Remarks – Experience:** Numerous comments over lunch regarding his "fondness" for George Bush and now I am sure his son as well.

**Present Status:**

Vice-President, Manufacturing Laboratories, Inc.  
Married, living in Nevada.

***Mike Braddock, MS University of Florida,  
1998-2000*** ***MTRC Years***

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**Thesis Topic:** “Design of a Control System for a Large Backlash High Friction Rotary Axis on a High Speed Milling Machine.” (1998-2000).

**Machines Used by Braddock:** MTRC HSM1 High Speed 5-Axis Milling Machine, Sunstrand Omnimill, MAZAK Quickturn 28N NC Turret Lathe, ANCA RGX Tool Grinder, MTRC Persuader ☺.

**Instrumentation Used:** 32 bit analyzer PC with 4 channel National Instruments data acquisition card running PC Scope and TXF, Load cells, PCB Instrumented hammers/accelerometers, in house built piezo-electric table dynamometer. Programs were written in PMAC, MATLAB and C.

**Laboratory Colleagues:** Matt Dean, Tony Kakeil, Christopher Martin, Chris Pearson, Michael Pecchio, Dave Peterson, Tony Schmitz, Babu Sirvaraman, Andrew Smith, David Smith, Yazid Tohme, Ahmed Yousuf, Scott Zeeb.

**Graduate Student Life under Prof. Tlusty:** Instructive, rewarding, difficult, educational, challenging, sometimes frustrating, disciplined, very practical, great experience.



**Mike Braddock and Scott Zeeb with HSM -1, five axis high speed machining center designed and built at UF-MTRC.**

*Yazid Tohme, Ph.D. University of Florida, 1996-Present*

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*Florida Years*

**Ph.D. Dissertation Topic:** "Control of High Performance Linear Drives" (1998-Present),  
Undefended.

**Masters Thesis Topic:** "Performance of a High Speed Milling Machine Feed Drive Using  
a Rotary Servomotor" (1996-1998).

**Machines Used:** *High speed milling machine (HSM1) developed at the University of  
Florida, HSM2 retrofitted at the University of Florida and Sundstrand Omnimil.*

**Instrumentation Used:** *DSP boards, A/D boards, Delta Tau motion control system,  
Fanuc control system, table dynamometer, vibration analysis software and instrumentation.*

**Projects:** *Control systems on HSM1 and HSM2, retrofitting of HSM2, machining of  
aluminum and hard steel and active damping.*

**Laboratory Colleagues:** *David Smith (Ph.D.), Andrew Smith, Michael Braddock, Scott  
Zeeb, Chris Pearson, Chris Martin, Michael Pecchio, Tony Kakiel, Sinan Badrawy (Post  
Doctoral), David Peterson, Matt Dean.*

**Graduate Student Life under Prof. Tlusty:** *Can't complain until I graduate.*

**Present Status**

Graduate Research Assistant.

Machine Tool Research Center, Department of Mechanical Engineering,  
University of Florida, Gainesville, FL. 32611, <http://mtrc.me.ufl.edu>

# *Chris Pearson, MS. University of Florida, 1998-2000*

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## *University of Florida Years*

**Thesis Topic:** "Development of a Post-Processor and User Interface for a Five-Axis Milling Machine." (1998-2000), defended in March 16, 2000.

**Machines Used by Pearson:** F.J. Lamb Vertical Mill, Sundstrand Omnimill, ANCA RGX 7 Axis Tool Grinder, MTRC Designed and Built Five-Axis High Speed Milling Machine.

**Instrumentation Used:** PMAC Motion controller; NI-DAQ Data Acquisition cards; an array of personal computers utilizing applications such as MATLAB, AutoCAD, Harmonizer®, and MilSim; machine tool interface software written in C/C++ along with the MS Windows API.

**Laboratory Colleagues:** David Smith, Andrew Smith, Yazid Tohme, Mike Braddock, Chris Martin, Matt Dean, Tony Kakiel, Scott Zeeb.

**Graduate Student Life under Prof. Tlusty:** Exposed to real world design and engineering tasks that required problem solving skills, self motivation, discipline, creativity, and an interest in the operation and success of the Machine Tool Research Center.

**Present Status:** Design Engineer for Space Structures at Harris Corporation, Melbourne, FL

**John Ziegert, Ph.D. University of Rhode Island,  
1989**

**University of Florida Machine Tool Research Center,  
1990-2001**

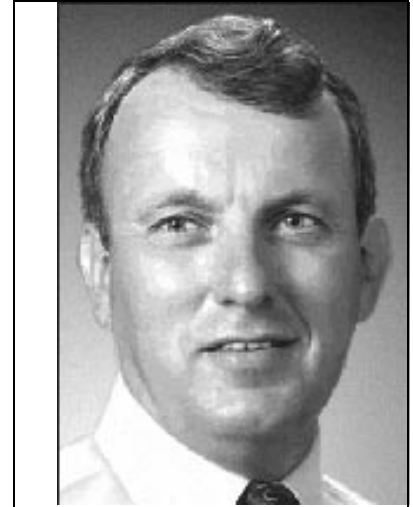
**Personal Remarks – Experience:**

*Although I wasn't one of Dr. Tlusty's students, I have learned more from working with him in the Machine Tool Research Center than from most of my previous formal education. I started at the University of Florida in 1990, with interests in robotics, and robot calibration. I had just started working on a small project for GE regarding machine tool calibration and accuracy, and I sought out Dr. Tlusty to discuss the project with him. I quickly learned how little I knew, and within a short time I found myself fully engaged in MTRC related activities. Those initial conversations sparked an interest in machine tool technology which continues today.*

*During my years working with Dr. Tlusty, I have been fortunate to participate in the design and building of two complete high speed milling machines using advanced axis drive technologies, while also learning about high speed milling of thin wall aluminum aircraft components, machining of titanium, advanced control algorithms for axis drives, design of high speed spindles, design and construction of ultra-high precision machines, machine tool metrology, tooling design, and many other topics. I continue to find myself amazed at the depth and breadth of Dr. Tlusty's knowledge regarding virtually all aspects of machining, machine tool design, and manufacturing technology. He is without question the best design engineer I have ever known, and all of the work I do in the future will continue to be influenced by his example.*

*One of the most impressive aspects of working with Dr. Tlusty on a daily basis is his ability to know not only the broad principles underlying machine tools and machining, but also the details. During one semester when I sat in on an advanced class he was teaching in machine tool dynamics, I watched with amazement as he walked into class every day with nothing but a piece of chalk and proceeded to write out complicated derivations and solve complex problems with no notes or aids. Countless times, at lunch or in the lab a subject would come up regarding anything from cutting mechanics to advanced control algorithms, and Dr. Tlusty would not only be conversant with the subject, but also would be able to recall from memory very specific details of expected and desired numerical values for material properties, machining parameters, stiffnesses, natural frequencies, etc., across an incredibly broad range of topics. He taught me the value of what he calls "knowing your numbers", and the importance of evaluating new ideas based on this knowledge.*

*Although Dr. Tlusty has a well deserved reputation as a stern task-master with no patience for fools, I have personally observed the care and concern for his students and colleagues which underlies this demeanor. As an example, when I was a new assistant professor, I had recently received some research funding to pursue an idea I had for applying neural network technology to machine tool error compensation. Although it was fairly obvious that Dr. Tlusty didn't think much of this approach, he never discouraged my work. Instead, he would occasionally ask me about our progress. This work was primarily computational in nature, and Dr. Tlusty would periodically ask me how we planned to obtain experimental confirmation. My original plan had been to do experiments at the plant of a corporate supporter whom I had worked with previously. However, in the recession of the early 90's, this plant was closed. A few months after learning of this, Dr. Tlusty told me he was planning to purchase a laser interferometer system for use in his research. He thought this might help me in my work, and asked if I had any money in my budget to contribute to the purchase. In fact, I desperately needed such an instrument, so I rearranged my budget as much as possible, but still could only come up with about \$6000 toward the \$25,000 cost of the system. Dr. Tlusty said that would be fine, and we went ahead and purchased the system. It wasn't until much later that I realized the measurements he was planning to use the interferometer for could have been done using equipment already on hand, and that a primary reason for this purchase on his part was to help me to succeed. For acts like this, and his continual willingness to include an*





*inexperienced young professor in his activities and share his knowledge and experience, I will always be grateful for the time I have been able to spend working with Dr. Tlusty.*

***Present Status***

Professor, Married with two children.

Machine Tool Research Center, Department of Mechanical Engineering,  
University of Florida, Gainesville, FL 32611, <http://mtrc.me.ufl.edu>



**1938: J. Tlustý, High School Graduate.**



**1956: With his first wife and three children.**



**1972: Joining McMaster University.**



**Approaching a ripe age with Hana Tlustý.**



Jiri Tlustý, Marvin Perrier, Milton Shaw – NAMC- II, 1974, Wisconsin Center.



Marvin DeVries, Francis Boulger, Jiri Tlustý, Milton Shaw. NAMRC IV, Columbus, Ohio, 1976.



**Left to right: Tlusty, Robert Hahn, Inyong Ham – NAMC XI, 1983, U. of Wisconsin.**



**Left to right: Jiri Tlusty, Hana Tlusty, Jim Bryan, Marvin DeVries.  
Stillwater, Oklahoma, 1993.**



**CIRP Dinner Reception, Stanford University, August 1991, Prof. Tlusty with his gang.** From right to left, Prof. T. Moriwaki (Research Associate, McMaster, 1974-76), Prof. S. Smith (Master student, Ph.D. assistant, and colleague, University of Florida), Mrs. Hana Tlusty, Prof. Tlusty, Professor Y. Altintas (Ph.D. student, McMaster, 1983-85), Prof. M. Elbestawi (Master and Ph.D. student, McMaster University, 1974-80).



**Professor Altintas visiting Professor Tlusty at his Crescent Beach Condo, November 1997.**



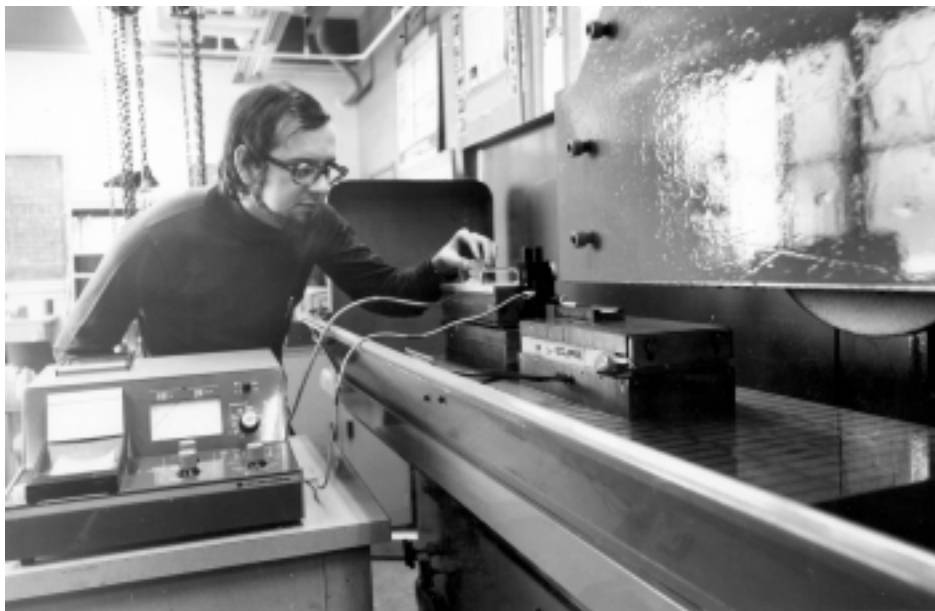
**Professors Altintas, Moriwaki, and Tlusty at his house. Gainesville, October 1999.**



Prof. Tlusty visiting former associates in Toronto. From left to right: Dr. W. Zaton (Postdoctoral Fellow, 1980-83, McMaster.), Prof. Tlusty, and Dr. Gordon Mutch (Ph.D. McMaster, 1975).



May 1973 - McMaster Lab. – Prof. Tlustý's Research Group. From right to left: Gordon Mutch (Ph.D. student), Yoram Koren (Assistant Research Scientist), Peter McNeal (MS student), Goel (Ph.D. student), F. Van Dyke (post-doc from Holland), and Mike Chen (MS student).

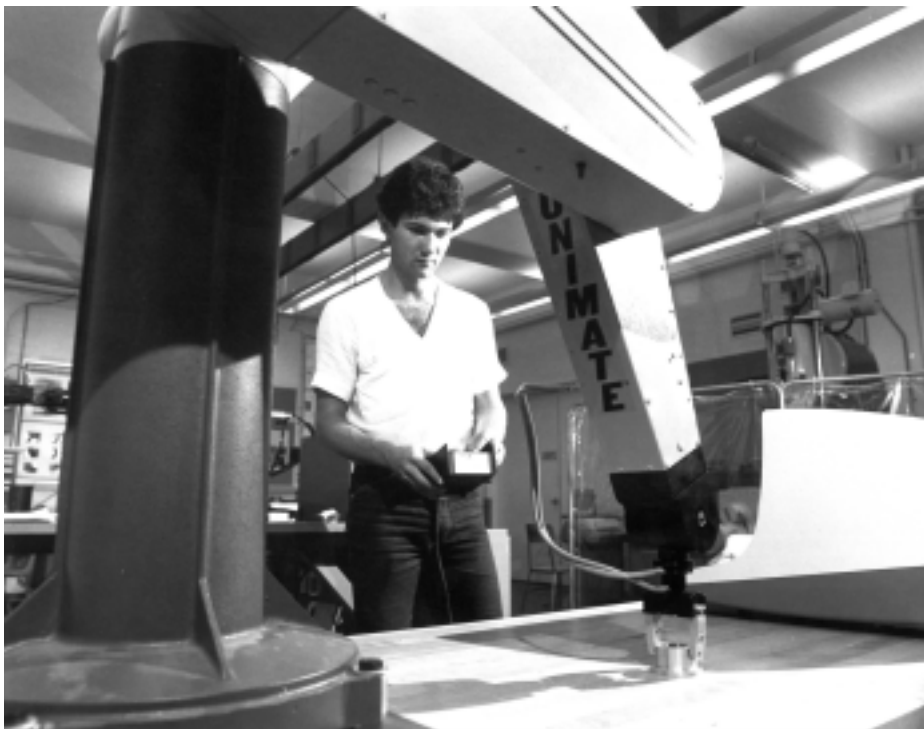


**Postdoctor F.Van Dyke, Working on the grinding machine.**





**Y. Koren, calibrating CNC-Adaptive Control system for TOS milling machine. McMaster University, May 1973.**



**Research Engineer Peter Young, working for Prof. J. Tlusty at McMaster University, 1989**