Olaf's Career Hilites

Background + Webpage & CV:

1. **Dr. Olaf O. Storaasli, 115 Adelphi Rd,**
   Oak Ridge TN, 37830 Phone: 757-553-0333
   Email: Olaf@cox.net Web: OlafTN.com

2. Key collaborators:

NASA: Jonathan Ransom (Structures Director)
Robert Fulton (supervisor '70-89), Jim Starnes
Jarek Sobieski, Bob Hodson, Tina Lotts, Jeff Stroud
Dennis Bushnell (Chief Scientist),
Joe Heyman (Chief Engineer)
Charlie Camarda (Astronaut)
NASA Contractors & Grantees:
Majdi Baddourah (Cray, LBL & Aramco HPC Lead)
Gene Poole (Cray), Jim Ortega (UVA), Merril Patrick (Duke), Harry Jordan (Colorado), & BOEING: Jim Tocher, John Turner, Ralph Miller & Wayne Erikson
Duc Nguyen (ODU Professor)
Kent Gilson (LaRC Hypercomputer Research)
Jeff Vetter & Ben Larson (ORNL Corporate Fellows)
Phil Roth (SC Tech Lead)
Jack Dongarra (UT, ORNL, Top500)
Horst Simon (NASA, NERSC, houseguest @NASA)
Global: Pål Bergan & Anne Elster (NTNU)
Sven Holmquist (Synective)
Charles Gillan (Queens Univ, Belfast)

3. Supercomputing Pioneer for Structural Analysis, Fast Solvers & Parallel Computing (FEM & FPGAs)

4. a. NASA Langley Research Center,
Hampton VA, 1970-2005.
Sr Researcher, Research Directorate
b. Oak Ridge National Laboratory (DOE),
Future Technology Group,
Computational Sciences Directorate,
Oak Ridge TN 2005-2012.
Distinguished Research Scientist

5. a. N.C. State Univ PhD 1970 Eng Mechanics/Math
b. Univ of South Dakota MA 1966 Math/Physics
c. Concordia College MN BA 1964 Physics Math French
+ PostDocs:
d. Norwegian Technical Univ + DNV 1984-85
e. Edinburgh Univ EPCC Visiting Academic 2008

6. Technical Record (links)
(a) Accomplishments: Overall CV + key items:

a. Olaf led Langley's **Finite Element Machine** FEM R&D Project, NASA's 1st Parallel Computer built in-house. The goal was to harness the growing computation power of microprocessors to solve FE analysis in parallel. After initial success linking 4 8-bit IMSAI 8080s to solve simple beam equations in parallel, Olaf's Langley team of a dozen software, hardware & applications experts built the FEM, a general-purpose parallel computer with 32 16-bit TI9900 processors, operating system & communication network. Success of the FEM to demonstrate the feasibility of solving structural analysis in parallel soon led to numerous parallel computer entering the market.

b. The Shuttle Challenger disaster led to NASA & Langley in-depth analysis & redesign efforts focussed on the Solid Rocket Booster (SRB). Olaf used new PVSolve & FORCE codes on NASA's new Cray-YMP to perform a detailed FE analysis on a detailed SRB model (54,870 equations vs <3000 on Marshall's Univac allowing <1000 nodes). The solution time for this 18.3X more detailed model was reduced from 14 hours (VAX) to 6 seconds on NASA's new Cray-YMP resulting in the **1st Cray GigaFlop Performance Award @SC89**.

c. PVSolve was in wide demand (Olaf posted 5 NASA FE models, PVSolve results & challenge to solve any faster. Developers worked with Olaf to use PVSolve to speed the GENOA Failure Analysis code resulting in it's selection for **NASA's Software-of-the-Year Award**

d. **Intel P6 Development System Award:** Olaf won an Intel worldwide competition to early access to an Intel R&D system at Langley with a prototype **P6 chip.** He installed PVSolve & Structures codes, providing weekly feedback resulting in Intel's redesign of a P6 companion chip to drastically improve off-chip floating point performance. For a decade Olaf active Board service on **ISUG** (Intel Supercomputer Users Group) helped guide Intel R&D from **Intel's Touchstone Delta** (**excellent parallel speedup**) to it's successful **Intel Hypercube** followon**.**

e. **NASA/Boeing Relational Database RIM5/RBase:** Under NASA's IPAD Boeing Contract, Olaf was key at NASA to develop an early relational database **RIM,** which evolved in the highly successful **R:BASE.**

f. **NASA & ORNL Accelerator (FPGA) Research:** PVSolve minimized matrix solution & FE analysis time on a spectrum of CPU-based computers, but Olaf's research showed FPGA-accelerated computers may be faster for many apps: FE Analysis, Climate, with DNA Sequencing 100-200x faster. A Hypercomputer innovation was graphical coding Olaf's Governor's School students adopted quickly to code a many Apps faster than traditional VHDL coding. Olaf developed firmware with FPGA developers at Cray, SGI, Xilinx, Altera,.. & a summer PostDoc the 64-FPGA Maxwell system at Edinburgh University, proposed/won a $25M NASA Project to build an FPGA-based multi-purpose (imaging, robotics,..) scalable, stackable NASA Space Computer before joining ORNL to head an FPGA-based Supercomputer R&D effort. After ORNL retirement Olaf worked on a Top Secret US Supercomputer application effort followed by a VP/Intl Rep position at Swedish FPGA-developer Synective Labs & Intl Reviewer for a European Union FPGA Project centered at Queens University, Belfast, UK.

,

g. **1st Mars Lander: Viking Structural Analysis:** Olaf used early **NASTRAN** versions with developers on Langley CDC6400 & 6600 Supercomputers to obtain Structural Analysis (Static, Dynamic & Frequency Response) for the Viking Spacecraft, the first to successfully land on Mars in 1976.

(b) Publications + Astronaut interview

(c) Technological Advancements

Parallel Processing: Algorithms=>FEM=>RIM=>Cray=>FPGAs

From 1970-75, Olaf joined NASA Langley's Automated Methods Section to conduct Finite Element R&D test & tradeoffs which led to NASA development of the commercial product **NASTRAN** (NASA Structural Analysis. These early evaluations & tradeoffs included meetings & evaluations with developers of the Force Method (McDonnell Douglas) & the Displacement Method (Boeing) that evolved from Ray Clough (UC-Berkeley), Olaf tested numerous codes at Langley, realizing great success with the displacement method selected by NASA for development of **NASTRAN** under contract (CSC & MSC). Olaf used early versions of **NASTRAN** alongside developers on Langley CDC6400 & 6600 Supercomputers to conduct Structural Analysis (Static, Dynamic & Frequency Response) for the Viking Spacecraft, the first to successfully land on Mars in 1976. **NASTRAN** grew to be the dominant commercial FE code. It & other FE codes soon became one of the biggest users of Supercomputer cycles for Aerospace, Automotive, Building & Marine Applications.

Olaf then focused on speeding matrix equation solution time dominant in FE Analysis. He led R&D solver NASA grant teams from Duke & ODU (direct method) & UVA (iterative).

Meanwhile, Olaf & his Langley colleagues recognized early on that microprocessor advances offered the computer industry, at reduced cost to "divide & conquer" by solving large applications in parallel. This led Olaf to develop **PVSolve**, a rapid matrix equation solver exploiting parallel & vectorization to speed Space Shuttle Solid Rocket Booster analysis time by 120X. PVSolve was released by NASA & used in numerous commercial

FE codes including versions of **NASTRAN** & ABAQAS as well as Langley's in-house Testbed FE code & version of the **SPAR/EAL** commercial code. Under NASA;s IPAD Project, Olaf was instrumental in the development of the an early relational database system **RIM**, under contract with Boeing which evolved in the highly successful **R:BASE**. Olaf was the 1st to port & demonstrate **AD-2000** (then core of dedicated CADCAM systems) to PRIME, opening the door to wide-scale CADCAM use on minicomputers. For a decade Olaf was active on the Board of ISUG (Intel Supercomputer Users Group) which helped Steer Intel's Supercomputers from **Intel's Touchstone Delta** at Caltech where Olaf demonstrated excellent parallel speedup to the successful **Intel Hypercube.** Olaf won an Intel worldwide competition to early access to an Intel development system at Langley with a prototype **P6 chip**. He installed PVSolve & Structural Analysis codes, providing weekly feedback resulting in Intel redesign of a P6 companion chip to drastically improve performance for off-chip floating point performance. **Olaf worked closely with Cray YMP, IBM-SP1, Starbridge HyperComputer & Synective Labs** developers by providing performance feedback on FE application tests.

(d) Peer interaction:

Revitalization of NASA thru computing: When **Jack Kerrebrock** left MIT to become new NASA Associate Administrator, one of his early actions was to convene a Summer Workshop of the top NASA Computer Science experts (several from each Center) to be co-housed at the UMD Retreat Center in Port Deposit MD with the leaders/

founders of the top US computer firms. The NASA team was tasked with bringing NASA into the modern era through computing with innovative ideas and a plan documented in a final report prepared for Dr. Kerrebrock by the end of the Workshop. Olaf soon became a key contributor as he roomed with Ken Wahlgren of NASA HQ during the Workshop, becoming familiar with all current & future NASA & US industry computer-related projects as well as working alongside US computer science leaders. Paul Schneck from NASA Goddard facilitated the Workshop & later convinced many of the NASA Workshop attendees to join the **IDA** funded Supercomputing Research Center midway between DC & Baltimore. Olaf was encouraged to leave NASA for SRC (but preferred open NASA research to CLASSIFIED SRC research) but on a visit saw Ken Wahlgren & **Burton Smith** creating a supercomputer in the basement designed to be a backup to Seymour Cray's innovations. When Olaf received the 1st Cray Performance Award at SC'89 he met Burton just when he'd got IDA permission to market his **Tera Supercomputer**. Olaf has attended most SC meetings since '89 representing NASA, ORNL & **Synective Labs**.

Led Finite Element Machine Team, Led IPAD Industry Technical Advisory Board (Aerospace & Computer Science Execs) on NASA $5 million, multi-year Integrated Program for Aerospace Vehicle Design Aerospace As NASA ITAB lead, Olaf arranged with Aerospace & Computer Company executives hosting ITAB meetings at their firms & Agendas including Project status, the latest innovations by

each company & numerous interaction with leaders of Boeing, IBM, DEC, McDonnell Douglas, Rockwell, CDC…
Provide evidence nominee achieved stature as a practitioner, manager, or **researcher of renown** in this area, to include involvement in **development of commercial products**.

Cray Performance Award

influenced Products: From 1970-75, Olaf joined NASA Langley's Automated Methods Section to conduct Finite Element R&D test & tradeoffs which led to NASA development of the commercial product **NASTRAN** (NASA Structural Analysis. These early evaluations & tradeoffs included meetings & evaluations with developers of the Force Method (McDonnell Douglas) & the Displacement Method (Boeing) that evolved from Ray Clough (UC-Berkeley), Olaf tested numerous codes at Langley, realizing great success with the displacement method selected by NASA for development of **NASTRAN** under contract (CSC & MSC). Olaf used early versions of **NASTRAN** alongside developers on Langley CDC6400 & 6600 Supercomputers to conduct Structural Analysis (Static, Dynamic & Frequency Response) for the Viking Spacecraft, the first to successfully land on Mars in 1976. **NASTRAN** grew to be the dominant commercial FE code. It & other FE codes soon became one of the biggest users of Supercomputer cycles for Aerospace, Automotive, Building & Marine Applications.

Olaf then focused on speeding matrix equation solution time dominant in FE Analysis. He led R&D solver NASA grant teams from Duke & ODU (direct method) & UVA (iterative).

Meanwhile, Olaf & his Langley colleagues recognized early on that microprocessor advances offered the computer industry, at

reduced cost to “divide & conquer” by solving large applications in parallel. This led Olaf to develop **PVSolve**, a rapid matrix equation solver exploiting parallel & vectorization to speed Space Shuttle Solid Rocket Booster analysis time by 120X. PVSolve was released by NASA & used in numerous commercial FE codes including versions of **NASTRAN** & ABAQAS as well as Langley’s in-house Testbed FE code & version of the **SPAR/EAL** commercial code. Under NASA’s IPAD Project, Olaf was instrumental in the development of the an early relational database system **RIM,** under contract with Boeing which evolved in the highly successful **R:BASE.** Olaf was the 1st to port & demonstrate **AD-2000** (then core of dedicated CADCAM systems) to PRIME, opening the door to wide-scale CADCAM use on minicomputers. For a decade Olaf was active on the Board of ISUG (Intel Supercomputer Users Group) which helped Steer Intel’s Supercomputers from **Intel’s Touchstone Delta** at Caltech where Olaf demonstrated excellent parallel speedup to the successful **Intel Hypercube.** Olaf won an Intel worldwide competition to early access to an Intel development system at Langley with a prototype **P6 chip.** He installed PVSolve & Structural Analysis codes, providing weekly feedback resulting in Intel redesign of a P6 companion chip to drastically improve performance for off-chip floating point performance. **Olaf worked closely with Cray YMP, IBM-SP1, Starbridge HyperComputer & Synective Labs** developers by providing performance feedback on FE application tests**.**
Olaf’s research is documented in 150+ technical papers/ publications/presentations & numerous invited talks (many overseas) during his NASA & ORNL careers

7. Interests: **Founder+President of Peninsula Computer Club** @NASA to share/demo monthly new computer HW& SW technology, upgrade systems en mass in NASA labs,… **Founder/President of ORNL iPhone Club** to share info on iPhone internals, apps, to exploit maximal capability. **Vikings of the Smokies**/Sons of Norway Founder+President