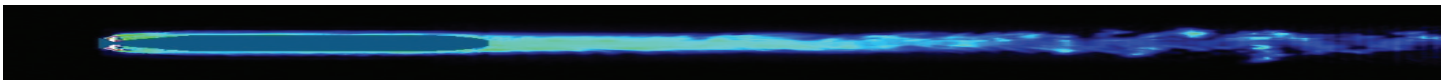
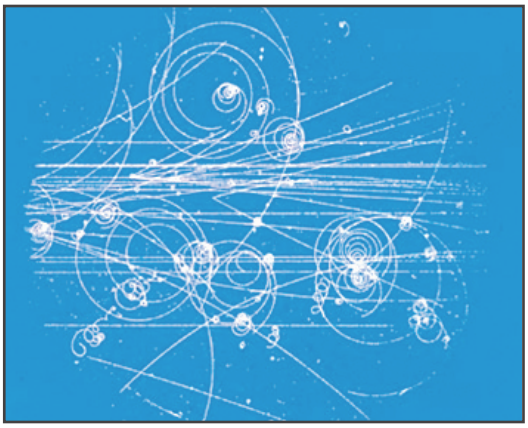
CAVITATION: FULL SPEED AHEAD



Numerical simulation of supercavitating body

Cavitation is officially defined as the formation of a vapor phase in a liquid, but as Professor Roger Arndt can tell you, it is so much more. A major focus of his research here at Saint Anthony Falls Laboratory, Arndt has been studying the effects of cavitation since he came to the University of Minnesota in 1977. Although SAFL designed the first of the large water tunnels that the U.S. Navy built after World War Two, naval research hit a lull after 1970- until Arndt arrived.

Since then, the Laboratory has been responsible for the hydrodynamic design of major research facilities around the world, including the premier facility for hydrodynamics research in Germany and the largest water tunnel in the world– located in Memphis, Tennessee. The experience gained from these projects has been utilized in the development of several facilities at SAFL as well, including the high-speed, multi-purpose, and jet water tunnels; the turbine test facilities; and a depressurized spillway test section.



Particle paths of an atypical cavitating flow

The term cavitation can imply anything from the initial formation of bubbles (inception) to large-scale, attached cavities (supercavitation). The formation of individual bubbles and subsequent development of attached cavities is directly related to reductions in pressure, which in turn is associated with dynamical effects, either in a flowing liquid or in an acoustical field. Cavitation can occur in any object handling or moving through a liquid, and can have both negative and positive effects. Cavitation can degrade performance, cause noise and vibration, and erode components. Yet cavitation has also revolutionized the field of medicine with ultrasonic kidney stone removal, made homogenized milk possible, and been part of sophisticated drug delivery systems. New techniques are also being developed for use in pollution control, specifically the cleaning of bilge water to improve harbor environments.

In addition to the deleterious effects on performance, noise and vibration, there is the possibility of cavitation damage. Although any device handling liquids is subject to cavitation, Professor Arndt is particularly interested in studying how cavitation affects the performance of turbomachinery. This is typically done by mimicking turbine and pump behavior by establishing a hydrofoil in a flow. Because cavitation always results in an unsteady flow (despite a stable foil), a numerical technique is used to calculate the exact vortex structure of the bubbly wake that occurs. Due to this unstable flow, the lift on the foil oscillates and is unsteady, dramatically affecting the amount of lift that the foil can produce. Once these oscillations are observed with high speed video and simulated numerically, the effects of incondensable gas are incorporated into the model, and the unsteadiness can be measured with even greater precision. (In fact, the Arndt lab is the only research team that can accurately capture the unsteadiness of a flow.) The influence of various types of cavitation on lifting surfaces is being studied with a view towards controlling cavitation erosion in turbomachinery. In an effort to utilize acoustic methods for diagnosing cavitation erosion in large hydroturbines, the lab is also studying the noise radiation mechanisms associated with different types of cavitation.

Seemingly the stuff of science fiction, supercavitation has one of the most intriguing applications. The concept is rather simple: an object moving so fast that the only place it's touching (water) is the nose, where it generates a cavity and creates an envelope of vapor that provides zero or little drag. The U.S. Navy has actually succeeded in surpassing the speed of sound in water, which is five times faster than the speed of sound in air. Supercavitation is

Cavitation, continued on p. 6

In this issue

The Briefcase of St. Anthony Falls

By Gary Parker

Gary Parker, Professor and Interim Director at SAFL, will depart for the University of Illinois Urbana this summer, where he has accepted a joint appointment in the Department of Civil and Environmental Engineering and the Department of Geology.

When I arrived at St. Anthony Falls Laboratory in December of 1972 he was there, and he had already been there for a very long time. I was a new graduate student who kept getting lost in the maze of stairways and floors that make up the experimental part of the laboratory. He had been a student as well, and perhaps he still thought of himself as one.

His name is not relevant to who he was. I shall call him Mr. Liu. He was from mainland China. When he found his way to the United States, and by what circuitous route, I do not know; but perhaps he arrived at the University of Minnesota in the late 50's. His doctoral advisor was Prof. Lorenz Straub, the founder of the Laboratory and the advisor of my advisor, Prof. Alvin Anderson.

My first impression of my new doctoral advisor was one of immense patience and kindness. Sometime in early 1973 I entered his office for a scheduled appointment, to find him listening to a shabbily dressed man. My first view of this visitor was from behind, but I could discern a man no longer young, holding a curious briefcase in his hand, gesticulating and mumbling in barely comprehensible English. He had an irregular stubble of a beard. His clothing showed signs of repeated, poorly-executed mending. Prof. Anderson asked me to wait outside for a few minutes.

The briefcase was unforgettable. Once it was surely a whole briefcase, and the skeleton of the original had survived, but it was covered with a patchwork of random pieces of leather and cloth of every possible shape and color, sewn in place with coarse thread and string. A name never embodied Mr. Liu. Instead, the essence of him was his briefcase.

The precise details as to how Mr. Liu reached the state I saw him in the winter of 1973 is also not known to me. It is possible, however, to connect the threads into a story. I never met Prof. Straub, who died in 1963. A decade later his presence still permeated every corner of the laboratory, from the design of the Director's office (which allowed no one to enter or exit the Laboratory unobserved by Prof. Straub), to the edict that nothing should be left on one's desk when one departed in the evening, to the precision with which project files and photographs were archived. Prof. Straub must have had an exceedingly strong personality. There were many who still recalled him with awe.

Mr. Liu was one of these people. Upon the death of Prof. Straub, Mr. Liu was described as having "gone off the deep end." I can only speculate what this means. Long after I first met Mr. Liu, however, I found myself carrying in my arms another man, thin, gaunt and with a similar stubble of a beard, who had inadvertently overdosed on his medication and become comatose. This man, my brother-in-law, had been tipped into a gentle and benign, but totally debilitating and irreversible schizophrenia by a traumatic event in his early 20's. He has the advantage of a sister who will never give up on him.

Prof. Anderson never gave up on Mr. Liu, who visited the Laboratory weekly. Mr. Liu would talk about "Dr. Straub," who was not dead, who came to talk to him nightly. Prof. Anderson would suggest small research projects in the hopes of pulling Mr. Liu back, but Mr. Liu always needed to consult with "Dr. Straub." I attempted to engage Mr. Liu on several occasions before giving up. I learned from him that I was an illusion, indeed I did not exist, nor did anyone who had first appeared to him subsequent to the death of "Dr. Straub." Perhaps he was, and has always been, right.

Mr. Liu's visits were always on Thursday afternoons. Until several years ago Thursday was seminar day at the Laboratory, a day apparently decreed by Prof. Straub himself. Mr. Liu would appear, seemingly out of nowhere, with his makeshift briefcase dangling from one hand. He would make the rounds of those he knew before "Dr. Straub" died, and then proceed to "The Lorenz G. Straub Memorial Library" according to the inscription on the door. In that library was a glass-encased box containing memorabilia from Prof. Straub's career. (The box has since been moved to the hallway outside the auditorium.) Mr. Liu would seat himself at the table next to the case and wearily extract from his briefcase a well-worn but clearly cherished copy of the classic text on hydrodynamics by Milne-Thompson. He would open the book to a specific page and place it on the glass top of the memorabilia case. He would then perform some kind of ritual. Upon completion he would disappear into the nowhere from whence he had emerged.

Sometime in the late 1980's the library door was locked to prevent the disappearance of books. The key was available from the editorialist. But the editorialist did not exist, because she was not known to Mr. Liu before Prof. Straub died. At first Mr. Liu tried the knob several times, and then, with a perplexed look on his ever more wrinkled face, turned and left.

But then he began to appear again, on schedule every Thursday afternoon. He had confronted the problem and solved it. He would stoop in front of the glass door of the library, and extract from his briefcase a piece of cardboard, a pair of scissors and a roll of tape. He would then take measure by eye of the inscription, "The Lorenz G. Straub Memorial Library," on the door, carefully cut a piece of cardboard of the right size, and then tape it over the word "Memorial," because he is not dead, no, he lives, he comes nightly, he talks to me, he is the reality and all those others are illusions.

The last time I saw Mr. Liu was in the mid 90's. I was in a coffee shop in Dinkytown when I saw the shabby man, with his shabby briefcase hanging from his loosely curled fist, standing on the sidewalk in front of the window, engaged in an animated monologue directed at a young, hippie couple. Prof. Anderson had taught me to be patient, so I bided my time. The monologue went on for over 20 minutes. Then he abruptly turned and shuffled away.

Gary Parker, continued on p. 9

NCED Launches Stream Restoration Project

The project's scientists are a multidisciplinary group – with expertise in river mechanics, sediment transport, stream ecology, hydrology, and geomorphology – and a major focus is the integration of these disciplines into a cohesive approach to restoration. In addition to the basic science of channel and channel systems, applicable "tools" will be produced that are applicable to common restoration scenarios and usable by restoration practitioners.

The National Center for Earth-surface Dynamics (NCED) has launched a River Restoration Project whose mission is to make significant contributions to providing a sound scientific basis for landscape and channel restoration. While the project focuses on research, the project team plans to make significant advances in restoration training and in facilitation communication in the community of restoration practitioners.

To get the Stream Restoration Project off and running, NCED convened a meeting of its Partner organizations in March, 2005. The meeting's objective was to examine the current state of restoration science, practice, and training; to identify major gaps in these areas, and to begin to set an agenda for moving the field forward.

Restoration project on the Missouri River

State of the science

Although many participants came with a list of specific issues in basic restoration science and practice to be addressed, most of the discussion focused on knowledge gaps concerning the group's overall approach. Five major concerns were identified: (1) Basic scientific knowledge is not making it into practice. Estimates of the time-lag between "state of the science" and the "state of the art" ranged from 20 to 50 years. (2) The practice of restoration is too often seen as a single-discipline problem – a problem in geomorphology, for example, or ecological restoration. Rarely are the ecological consequences of physically altering the stream, or the morphological consequences of re-tooling the ecology, considered. (3) The science of stream restoration is usually limited to "reach scale" considerations. Many participants called for basin-scale models and tools, a "corridor management" mindset that forces restorers to consider consequences both up- and down-stream of their intervention. (4) The science of restoration needs to move beyond the "reference reach" template. While restoring the stream to some pre-modern state is often the goal, a scientific basis for stream restoration must apply to all real-world situations. (5) The restoration community needs to incorporate post-design monitoring and reporting into all restoration projects. A lack of restoration forensics and reporting ensures that the gaps between knowledge and practice grow wider with time.

Tools and Methods

Discussion of the needs for new or improved application methodologies covered a great deal of ground, and many suggestions for specific tools and/or research were made. Some common themes included the need to integrate biology/ecology into tools that for the most part deal only with the physical side of restoration; tools that better translate current science into a form usable by practitioners; tools that incorporate uncertainty in quantifiable ways; tools that guide practitioners in adopting appropriate post-design monitoring; and tools to

Stream Restoration, continued on p. 11

The SAFL/NCED Proposal for an Outdoor Research Facility

In the summer of 2004, SAFL and NCED representatives began a series of meetings with Xcel Energy regarding the use of the two wasteways near the Falls. These wasteways provide a desirable facility regarding access, security, and water requirements, and are ideal for conducting basic and applied research in stream restoration and bioengineering. Xcel welcomed the proposal and planning commenced in late summer.

Included in the plan are designs for constructing channels in the fill material placed in the abandoned wasteways. The Wasteway 1 channel will be supplied from a surface water intake located in the St. Anthony Falls (upper) pool. Normal flows to this channel will be approximately 30 cfs. Maximum flows of up to 300 cfs will only be operated once or twice a year, for short durations. A concrete intake structure will provide water to two reinforced pipes that will then convey water to a headtank located at the upstream end of Wasteway 1. The headtank will be designed to dissipate energy from the pipe flow, providing a still water surface.

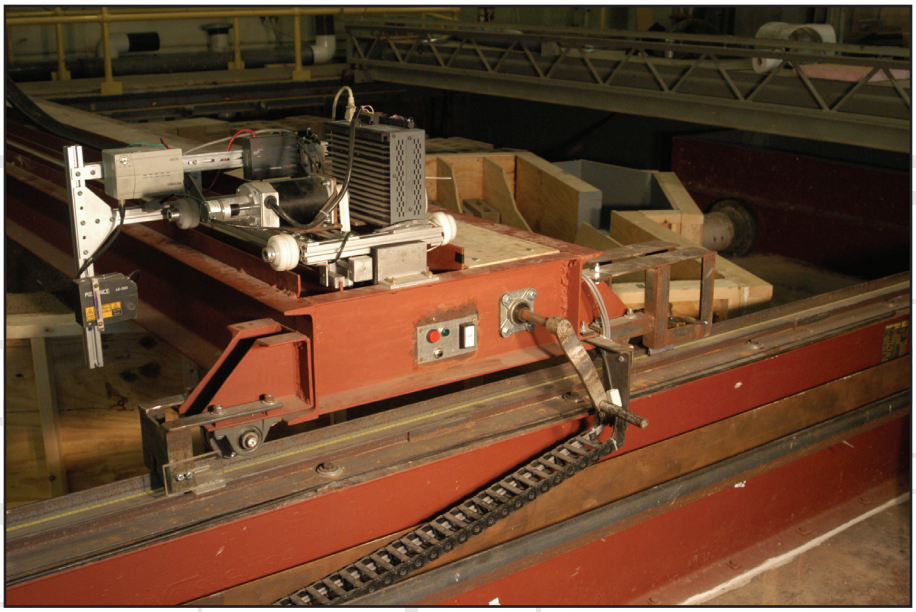
The geometry and configuration of experimental channels will vary across research projects, however, the maximum top width of the channel is anticipated not to exceed 40 ft and the maximum depth will be approximately 5 ft. At the downstream end of Wasteway 1, flows will fall from the drop leaf gate to a sedimentation basin, and then pass over a series of rock vanes which will control flow energy and provide passage for small fish that may enter the channel.

The Wasteway 2 channel will be supplied by diverting water from the existing SAFL supply channel. A pipe will convey water through the stone masonry wall to a headtank located downstream of the Wasteway 2 headwork piers. Normal flows to this channel will range from 10-100 cfs, with maximum flows operated infrequently and for short periods of time. The experiments in Wasteway 2 will vary from slope erosion (using artificial rainfall) to model scales of natural rivers and streams.

The plans are currently being reviewed by the Federal Energy Regulatory Commission for approval.

—Omid Mohseni

At SAFL we offer quantitative predictions or explanations of the real world using data from miniature models. Our unique experimental facilities give us a great opportunity to mimic numerous interesting real-world processes. The problem posed to SAFL's instrumentation specialists is this: How can we extract the data we need from these models?

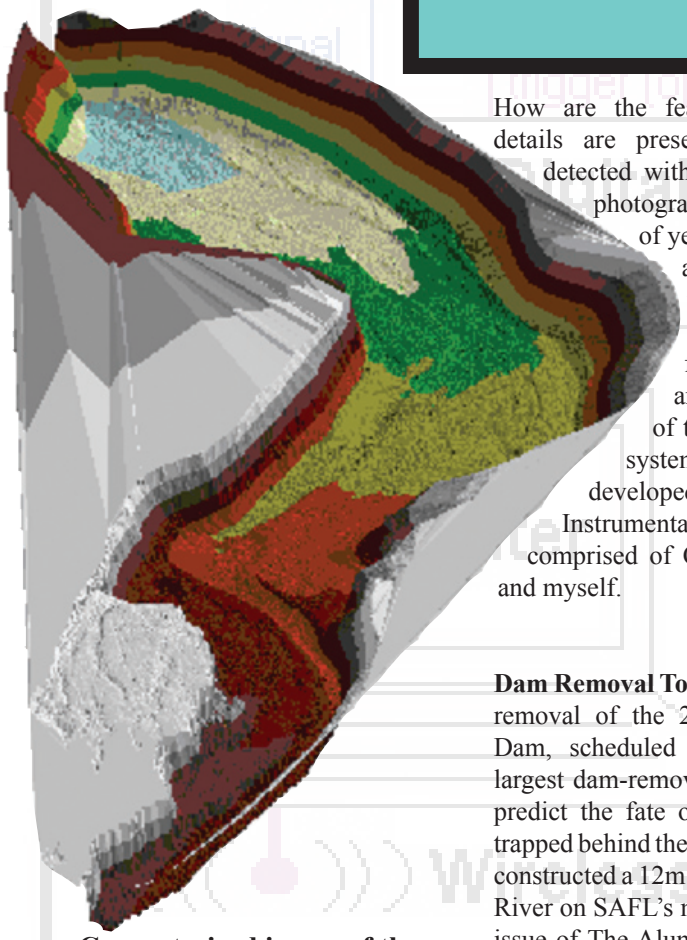


The Dam Removal Scanner, located on SAFL's model floor, converts real 3D features to a digital image

Surface Measurement

By Brett Otteson,

As a geology and civil engineering lab our efforts are frequently focused on questions about erosion and sediment transport phenomena, e.g.: What are the salient features of this miniature model landscape?



Computerized image of the Elwha model basin

How are the features changing? What details are present that could not be detected with the naked eye or in a photograph? In the past couple of years SAFL has developed a number of specialized measurement tools to answer these questions for scale models. In this article, I will discuss three of the surface measurement systems that have been developed here in our lab by the Instrumentation Team, which is comprised of Chris Ellis, Jim Mullen, and myself.

Dam Removal Topography Scanner: The removal of the 210-foot Glines Canyon Dam, scheduled for 2008, will be the largest dam-removal project in history. To predict the fate of 80 years of sediment trapped behind the structure, Chris Bromley constructed a 12m long replica of the Elwha River on SAFL's model floor (see previous issue of The Alumni Channel). Above the model, a laser point gauge traversed the landscape to produce digital surface maps of the sediment below.

The system employs a standard desktop computer, a motor drive computer, a stepper motor, and a precision triangulating laser distance sensor. The sensor can detect any diffuse surface up to 750mm away and report its position accurately to 1/3mm. Unfortunately for Bromley and his student employees, the scanner was automated in only one dimension, so it required a sizeable chunk of time (2-3 hours depending on the area in question) to gather the 2D information. However, this did not deter him from taking over 400 area scans of 14 different removal scenarios. Data from the scanner enables Chris to quantify precisely where sediment is moving to and from under each scenario.

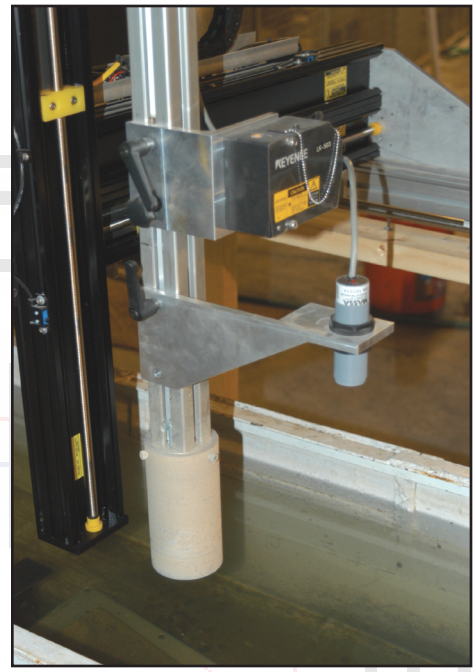
Underwater Scanner: To find oil deposits buried at the bottom of the ocean, oil companies search for topographical features called "micro-channels," narrow (100m) depressions in the sea floor. In 2004, a facility was constructed in SAFL's

main channel to study the formation of these features. The scanning system was laid out in much the same way as the Dam Removal Scanner with a few important differences: (1) Draining the main channel would destroy the features under study, so the scanner had to be waterproof and able to see up to 2m below the surface. (2) The small size of the micro-channels required an increase in overall system accuracy. (3) Due to the amount of data involved, it was necessary to invest in a fully automated scanner.

The completed system contains a laser sensor, 2 motors, 2 drive computers, and a standard desktop. The laser is sealed inside a telescoping plastic tube with a glass window on its underside. Control software allows the user to define a rectangular sampling grid, press *go,* and return when the scan is complete. The automated arrangement has allowed research fellow Alessandro Cantelli to achieve a measurement resolution of (1mm) x (10mm) over the (2m) x (10m) area.

Stillwater Sciences Instrument Carriage: Beginning in the spring of 2004, SAFL engineers undertook an ambitious project in collaboration with UC Berkeley to construct an instrumentation system capable of fast, accurate measurement of sub-aerial and sub-aqueous topography in Berkeley's newly-refurbished 30m tilting flume. The flume's sediment recirculation system, also designed at SAFL, handles stones up to 64mm, eliminating the possibility of an underwater laser measurement system, which would be cumbersome and vulnerable to scratches in this environment. In March 2005, the Instrumentation Team delivered a 3-instrument carriage, automated in all 3 dimensions, to Berkeley. The carriage comprises:

- An underwater sonar probe to measure bed topography while the flume is in use.
- Another sonar probe to measure distances through air. This probe finds the distance to the water surface or the ground (whichever is highest). It is used to position the underwater sonar probe and avoid collisions with objects in the flume.
- A laser sensor, capable of high speed topography scans when the flume bed is dry.



The Stillwater Sciences Instrument Carriage (pre-shipment at SAFL)

The machine can sample all three sensors at 150 measurements per second. The measurement data is computed in real-time and made available to the system processor, which uses the information to continuously reposition itself down the length of the flume. Achieving this degree of speed and synchronization on a normal Windows computer is no mean feat, and is testament to the skill of SAFL software expert Jim Mullin. Control of the three sensors, three motors, and sediment feed system was integrated into a single software package that will allow users at Berkeley to create their own measurement schedule and let the system execute it, recording data to their specifications.

The Stillwater Instrument Package represents the state of the art in SAFL's surface measurement technologies. This project incurred a large amount of expense for the research and development of its hardware and software. Now that this groundwork has been laid, it is hoped that in the future a similar system may be implemented for one of SAFL's flumes at a much lower cost.

Technology at SAFL

Instrumentation Engineer

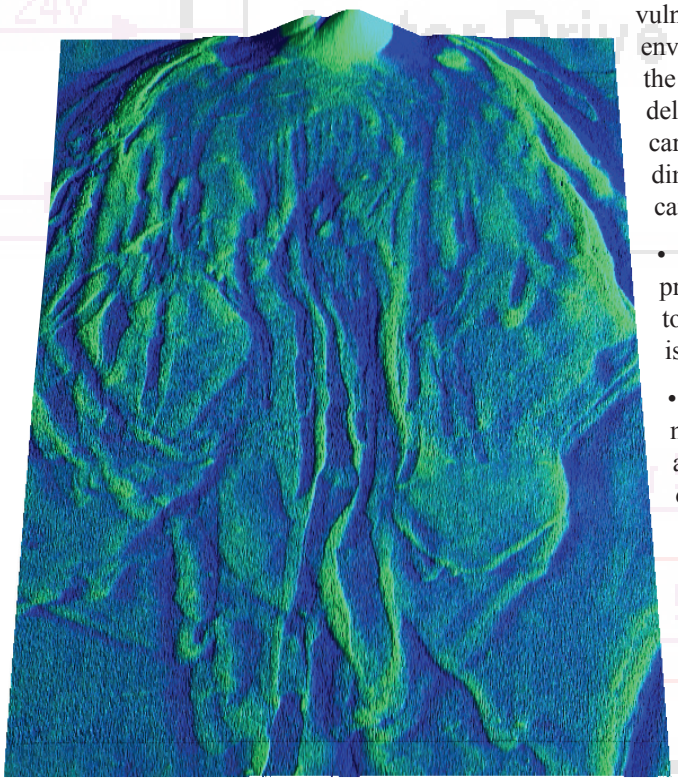


Image of an experimental submarine fan recorded using SAFL'S Underwater Scanner.

THE EYE OF THE STORM

SAFL Alumnus Speaks On Rebuilding After The Tsunami

Suresh Hettiarachchi (MA'98) was a guest presenter for a special seminar at SAFL in early February, 2005. He is originally from Colombo, Sri Lanka and was there on vacation during the December 2004 tsunami. He currently works as a water-resources engineer with HDR Engineering Inc. in Golden Valley.

For someone who had been present for one of the world's largest disasters, he seemed fairly calm. In fact, Hettiarachchi opened his talk by joking that the only early warning system in place at the time were the animals of Yala National Park, who all fled well before the earthquake had even hit Indonesia. However, both the government and the general population were taken entirely by surprise: "There was no organization in existence to deal with a situation like this. No one even knew what a tsunami was," said Hettiarachchi. The wave hit the northern tip and traveled down the east coast and around the southern tip killing over 35,000 and resulting in an estimated two million homeless. In the days immediately following the tsunami, Hettiarachchi and friends helped to disburse relief in the forms of dry food, water, clothes and medicine that came into the southern capitol of Colombo.

Since the government of Sri Lanka had no established development organization when the tsunami hit, they turned to the newly formed Urban Development Authority and their architects for reconstruction assistance. The city of Hambantota (on the southern tip) was hit the hardest structurally. Nearby Kirinda is where Hettiarachchi's work efforts have been focused.

Using his engineering background, he and a team of others developed a town plan for Kirinda that includes rebuilding houses and helping local residents reestablish their means of living. Speaking of his plans to prioritize rainwater capture using step-down catchments for separate areas, Hettiarachchi said, "The present plan is to have individual collection tanks at each house with an initial flush. The capacity of most of the individual tanks is around 800 liters. Hence we want to build stepped catchments, meaning we want to capture the excess flow from these tanks in downstream catchments installed in series." The UDA has approved their town plan and is now using it as a model for others.

> ***"No one even knew what a tsunami was."***

When asked what steps have been taken to prepare for future disasters of this kind, he stated, "A 100 meter 'no build zone' has been established to mitigate the damage from any future waves. The Center for National Operations has been established to help coordinate relief efforts, which will help in any future disaster."

Hettiarachchi returned to Sri Lanka at the end of February on personal leave to continue aiding in organizing supplies and services. When asked about his hopes for the future, he was realistic. "The total environmental impacts are beyond one person's perception. The contamination is lasting longer than people expected. The well water is still pretty salty. The largest issue will come during the rapid reconstruction period when environmental impacts might potentially be ignored." But he doesn't sound defeated when he jokes that the tsunami hasn't made him scared of the ocean. "Life continues. The animals have returned to the park. The southern and eastern coasts are already coming back, bit by bit. The hope is to rebuild and develop an even better Sri Lanka."

—Maia Homstad

Cavitation from page one

now at the forefront of many military research efforts, and Arndt is no stranger to its study and applications. While at Lockheed, California (as a senior research engineer in the early 1960's) he worked on the design of an 80-knot ship. These days, high speed hydrofoil technology is coming into the fore again with recent naval designs for a 70-knot ship. "It just goes to show you, what goes around, comes around. Nothing is truly new," remarked Arndt.

Currently, Arndt is working in collaboration with Professor Emeritus Charles Song and Research Associate Martin Wosnik on the design and model construction of a LOCAT (Low Noise Large Cavitation Tunnel), which has been commissioned for hydroacoustic and cavitation testing. (For more information on this project, see LOCAT article on p. 8.)

—Maia Homstad

CAVITATION IN NATURE

Snapping Shrimp can ruin the day for a sonar operator. Underwater, they sound like a bunch of crickets, and millions of them together can create a sound that's overwhelming. When hungry, each individual shrimp squirts out a jet of water at speeds so great that the pressure drops low enough to create cavitation. Similar to a depth charge, these underwater explosions are used to stun any prey that has the misfortune of crossing the shrimp's path.

Supporters Keep SAFL Afloat

SAFL gratefully acknowledges the following individuals for their generous gifts this year:

Charles B Andrews
Roger E A & Jane E Arndt
Linda J & Avrham Ettedgue
Jill Bagenstos
Douglas W Barr
Sharon L Bartlett
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George Bugliarello
Hak-Soon Chang
Yantao Cui
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K Warren Frizell
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Michael J Riley
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Frank R Schiebe
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Idell B & Edward Silberman
Sheldon & Melissa C Silberman
Heinz G Stefan
Charles C S & Irene L Y Song
Oren J & Sharron L Steinfeldt
Frank Y & Julie C Tsai
Katherine F Walter
Helen S Wolk
Alwin Young & So Lian Tio
Mostafa Family Trust

If your name is missing or listed incorrectly, please email Maia Homstad at homst004@umn.edu.

ANDERSON AWARD DONATIONS

I write you in regard to our Anderson Award Fund of St. Anthony Falls Laboratory, Department of Civil Engineering. Recently one of our very loyal alumni, Dr. Alwin Young, made a generous contribution to the Anderson Award Fund, with a request that a fundraising drive be initiated to replenish the fund. As Interim Director of St. Anthony Falls Laboratory and a former student of Prof. Anderson, I heartily concur, and have also made a donation to the fund for my part.

—Professor Gary Parker

The Alvin G. Anderson Award was established by the family and friends of Dr. Anderson, a former Director of SAFL, after his death in office in 1975. The award is available annually, on nomination by a faculty member, to a student at the University of Minnesota pursuing graduate studies in the water resources area. Award recipients receive books of their choice relating to their study interests.

To make a contribution to the Anderson Award Fund, please contact Jennifer Clarke, Development Officer, at jclarke@mail.itdean.umn.edu or (612) 626-9354. You may also make a gift directly through the UMN

Edward Silberman Fellowship Fund

For Edward Silberman, retired professor and former director of the St. Anthony Falls Laboratory, the perfect birthday present is a fellowship that builds on his legacy.

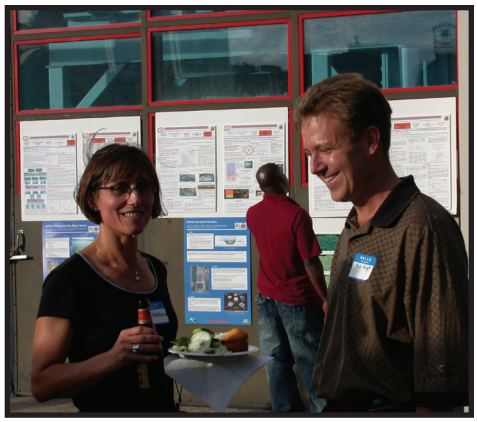
Son Cyril Silberman helped lauch the **Edward Silberman Fellowship Fund** with a $175,000 gift at Professor Silberman's birthday party in February 2004.

Since that time, four dozen other donors have contributed to the fellowship. All payouts from the Fund are matched equally by the Graduate School.

This year's Silberman Fellowship Award was presented on March 23rd, 2005 to Miguel Wong, a PhD student studying with Gary Parker.

Left to right: Idell, Edward, and Cyril Silberman with Miguel Wong

SAFL ANNUAL PICNIC



Professor Efi Foufoula-Georgiou and Rick Voigt (MS '85)

Doug Barr (MS '49) and Jennifer Clarke, IT Devlopment Officer

Feng and Jennie Hsiao with Ed Silberman, Professor Emeritus

Socializing on the lower deck near the stone arch bridge.

Graduate students Miguel Wong, Matt Carper and Ben O'Connor

Marty Halvorson (MS '91) and Professor John Gulliver

Bert Wulf (volunteer) with Rocky Fanjoy (former Shop Foreman)

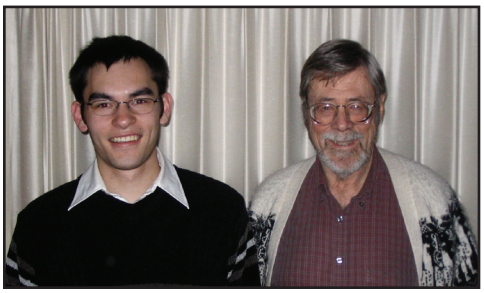
DEPARTMENTAL NEWS:

- Research Associate **Sukanta Basu** (PhD '04) received an offer from the Texas Tech University (tenure track position) where he will join the Atmospheric Science department next fall. He will also be affiliated with the Wind Science and Engineering Research Center there.
- Ph.D. students **Michal Tal** and **Wonsuck Kim** both received Outstanding Student Paper awards for their presentations at the 2004 American Geophysical Union.
- **Wonsuck Kim** also received the Richard Clarence Dennis Graduate Fellowship during the 2004-5 academic year.
- **Damien Kawakami, Wonsuck Kim, Ben O'Connor, Ben Sheets** and **Lisa Tilman** were all recipients of **Frank & Julie Tsai Travel Awards** during the 2004-5 academic year.

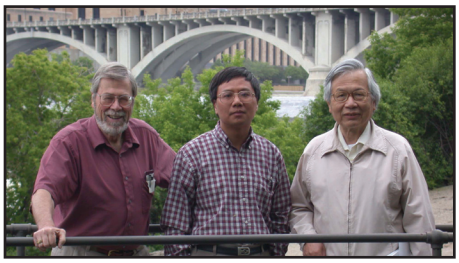
Recent SAFL Graduates

Sukanta Basu (PhD '04)
Advisors: Efi Foufoula-Georgiou and Fernando Porte-Agel

Stephanie Johnson (MS '04)
Advisor: Heinz Stefan

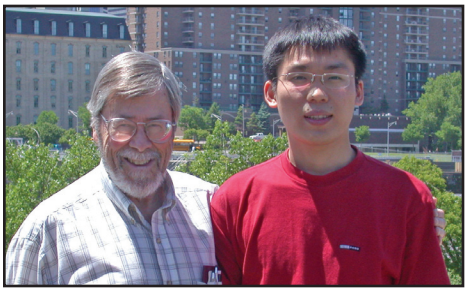


Damien Kawakami (MS '04)
Advisor: Roger Arndt



Qiao Qin (PhD '04)
Advisors: Roger Arndt & Charles Song

Ben Sheets (PhD '04)
Advisor: Chris Paola



Hong Wang (MS '04)
Advisor: Roger Arndt

RECENT AWARDS

ALVIN G. ANDERSON AWARD: Wes Lauer, a PhD student with Gary Parker, received the 2005 Anderson Award.

LORENZ G. STRAUB AWARD: The 2002 Straub Award was granted to **Dr. Emily Anne Zedler** for her dissertation on *Large Eddy Simulation of Sediment Transport in Oscillatory Flow Over a Wavy Terrain.* Her advisor was Prof. Robert Street at Stanford University.

EDWARD SILBERMAN FELLOWSHIP: Miguel Wong, PhD student with Gary Parker, is the 2005 recipient.

Gary Parker from page 2

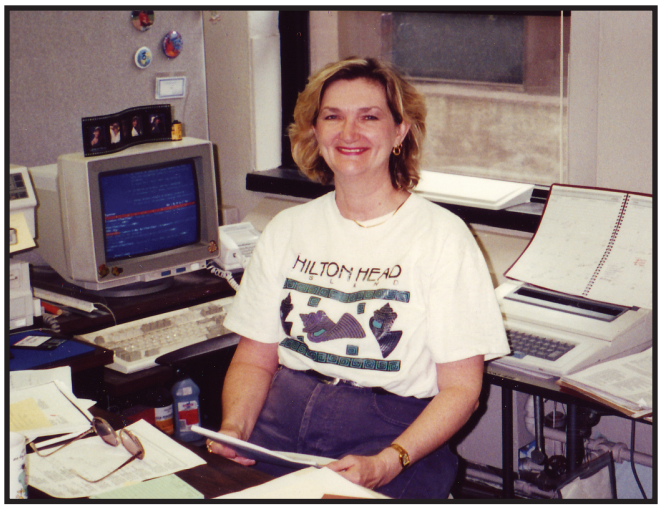
I approached the couple and asked them what Mr. Liu had said. They told me that they had heard about a great man, a benevolent man who could do wonderful things, who was still with us, those illusions and what they said were false, and soon this great man would demonstrate this, it was only a matter of time, one had to be patient.

This was the only time I saw Mr. Liu address people who not only did not know Prof. Straub, but who could not possibly have been alive before he died. Had something changed within him? Perhaps he had a premonition of sorts, and perhaps this was his last will and testament, because not long afterward he stopped coming to the Laboratory with his briefcase, his cardboard, his scissors and his tape. And then I learned, indirectly as always, that he had died.

I carry Mr. Liu in my memory. I carry the memory of the kindness of Prof. Alvin Anderson. I carry the memory of the man I never met, the man who founded the laboratory where I received my doctoral degree. And after 25 years as a professor at the same laboratory, I depart with the image of a briefcase cobbled from many shards, a briefcase embodying the enduring treasure left to Mr. Liu after all other meaning in his life had fallen away.

Remembering Pat...

Pat Swanson began working at Saint Anthony Falls Laboratory as a Senior Secretary in 1968 when Ed Silberman was Director and Mary Marsh was Administrator. In 1974 she took a leave of absence to raise her two children. Three years later Mary, who was to become her mentor, asked Pat to return to SAFL to organize project files and archive reports. Upon completion of the project she accepted an appointment as Editor. Then Director Roger Arndt put his confidence in Pat to complete the publication of a brochure for SAFL. This inspired her to become more involved in publications and marketing and, after taking classes in Journalism and Communication, she was promoted to Senior Editor— a position she held for twenty-three years. Although she retired on February 8, 2003, her insight and perspective continues to be a valuable part of the Lab. She is remembered and missed by many. An exit interview with Diana Dalbotten (who was mentored by Pat in their earlier years) contributed to the following article.



Lab History

Although Pat credits Mary Marsh with initiating the monumental task of collecting Lab history, it was a decades-long project that Pat remained dedicated to throughout her career here. "I believe that it's important to document our research, our students, and our alumni, as well as our directors and their years of service. I wanted to leave SAFL with a record of its history, of projects and publications that others can enjoy and use to support future engineering research. These have included many brochures, a website, a catalog of reports and published research of the faculty, a database of clients and alumni, historical and project photos, a retention of motion pictures documented in the earlier years, and a collection of project files on many (now famous) projects completed over the years."

"The Lorenz G. Straub Library has been retained throughout the years by many on a volunteer basis. Many times I felt like giving up on that effort, but there was always some student or faculty member that would convince me that my efforts were appreciated and that I should fight for the library's survival. The revitalization of the LGS Library was a collaborative effort between me and John Gulliver to establish a SAFL Alumni Fund, of which monies were initially used to revitalize, redecorate, purchase new books and reorganize its holdings. From this effort the *Alumni Channel* and the alumni database were born."

The People

When asked about her experiences working with four different directors, Pat said, "Ed Silberman had a photographic memory. He was very involved... He could joke around, but was very structured during work hours. Roger Arndt treated me like a professional and really helped my career. Gary Parker was a very supportive advocate and honest; he always wore his feelings on his sleeve." At the time of Pat's retirement, Efi Foufoula-Georgiou was director. "I respect her energy and accomplishments. She set her goals very high; I achieved a lot in my career and personal growth from our working relationship." When asked what changes she had seen in the way people worked at SAFL over the years, Pat remembered that before computers, employees had to spend a lot of time on grunt work. "Now it is more important for an employee to be able to figure out the direction of their work themselves…not to wait for direction from others. One important thing that I learned over the years is that change is inevitable, and embracing and participating in change, rather than fighting it, is more rewarding."

On Family

Pat also spoke on family and work. "There are now more opportunities for working parents. At first if you were a woman and had a family they wouldn't hire you at all for important positions. My daughter has many more opportunities which women wouldn't have even been considered for when I was first working. Our generation fought for the rights that our children now enjoy."

Our Alumni

"I became interested in trying to compile a list of all the graduates for SAFL and to establish a line of communication with alumni via a newsletter. I feel the alumni are not only a part of SAFL because they came through the doors, but they are our history and our future. Many have become well-known engineers, entered academia, or hold important political positions, among other prestigious accomplishments. The Saint Anthony Falls alumni continue to be supportive in the research and activities of the Laboratory. We need to keep the lines of communication open and get them involved in visitor groups, workshops, and seminars."

For the future...

Pat played a key role in shepherding the NCED grant through the proposal process, helping to bring the Center to SAFL. With the start-up of the Center, Pat took up the role as the first Deputy Director of NCED. "I'm pleased that I retired when the Lab is on track for a bright future. The NCED effort has been very rewarding for me, and for those that are still here it will mean working hard to provide new insight into Earth-surface dynamics."

Update

Pat has moved to East Tennessee and is close to her family and childhood roots around Asheville, N.C. She reports, "The weather is warmer, hardly any snow, the views are breathtaking. I'm enjoying my piano and gardening, and am taking golf lessons." Pat and Russell Bird (formerly a Principal Jr. Scientist at SAFL) will celebrate their marriage of one year in April.

—Maia Homstad

LOCAT Model To Be Tested At SAFL

The Korea Ocean Research and Development Institute (KORDI) has commissioned a large water tunnel that will be used for both hydroacoustic and cavitation testing: the Low Noise Large Cavitation Tunnel (LOCAT). Due to extensive experience designing and testing comparable experimental facilities (for example, the HYKAT in Germany and the LCC in the United States), St Anthony Falls Laboratory was asked to provide design services for this project. Having a somewhat different configuration than conventional water tunnels, the LOCAT project will require a considerable analytic effort. Headed by Professor Roger Arndt, it will span both the conceptual design and detailed design activities currently proposed for the construction of the facility. Professor Emeritus Charles Song will contribute the necessary numerical analysis. A combination of both computational and physical models will then be used to predict the performance of the full-scale LOCAT. The physical model will be built and tested at SAFL. Associate Director of Applied Research Omid Mohseni, and Research Associate Martin Wosnik, are acting as principal investigators. Based on the results of these model tests, final design recommendations will be made.

This study will assist in the hydrodynamic design of a low background noise large water tunnel with overall dimensions of 60m x 20m x 5m, a test cross-section of 2.8m x 1.8m, and a length of 11m. In order to verify the performance of the preliminary design, a 1:6 scale model (using air as a testing medium) will be constructed at SAFL. This model will focus on the diffuser performance, establish the design of the turbulence management system, and check overall flow quality (including detailed measurements of pump inflow). A fan will be used to induce flow through the model, with a grid of bars at the bell mouth inlet to establish certain inflow levels of turbulence. Pressure, mean velocity, and turbulence levels will be measured; a series of pressure taps will be used to measure pressure distribution in the lower half of the contraction, the test section, and the diffuser. The flow distribution at various cross sections will be established via LDA (Laser Doppler Velocimetry). The numerical and physical models will be used to solve any flow problems that may arise during the experimental phase. Completion of the physical model portion of the project is expected to require eight months.

— Martin Wosnik and Maia Homstad

STORMWATER COMMITTEE AT SAFL

SAFL hosted over 40 individuals from public and private organizations at the Minnesota Stormwater Steering Committee meeting this March. The committee was created in 2004 with the vision to reduce the adverse environmental effects of stormwater discharges to Minnesota's surface and ground waters. Bruce Wilson from the MPCA (Minnesota Pollution Control Agency) chaired the meeting. After reports were given by subcommittee members, Professor Marvin Bauer from the UMN discussed the GIS mapping of impervious surfaces by satellite imagery. Jack Frost from the Metropolitan Council and Bruce Wilson from the MPCA introduced the current monitoring contracts and the types of input being sought for current and future contracts. Professor John Gulliver gave a presentation on the "Monitoring 'Best Management Practices' Effectiveness" component of the recent contract between the UMN Water Resources Center and the MPCA. The scope of this part of the contract is to provide a monitoring and evaluation protocol for the best management practices and technologies in treating stormwater. Professors Jeff Anderson, Larry Baker, Raymond Hozalski, John Nieber, and Bruce Wilson are also co-investigators for this portion of the project.

Following Professor Gulliver's presentation, Professor Heinz Stefan gave an overview of another component of the MPCA contract: addressing the impact assessment of the land use changes on trout streams. The goal of this part of the contract is to provide a tool for the MPCA to assess the thermal impacts of future developments on trout streams.

Finally, Roger Bannerman from the Wisconsin DNR discussed the progress of partnership opportunities between Minnesota and Wisconsin regarding research and development of the best management practices in treating stormwater.

— Omid Mohseni

Stream from page 3

help practitioners/stakeholders decide whether to intervene at all. Professor Gary Parker presented an outline of a Stream Restoration Toolbox that NCED researchers are developing for web dissemination, and invited all participants to contribute to it.

Training

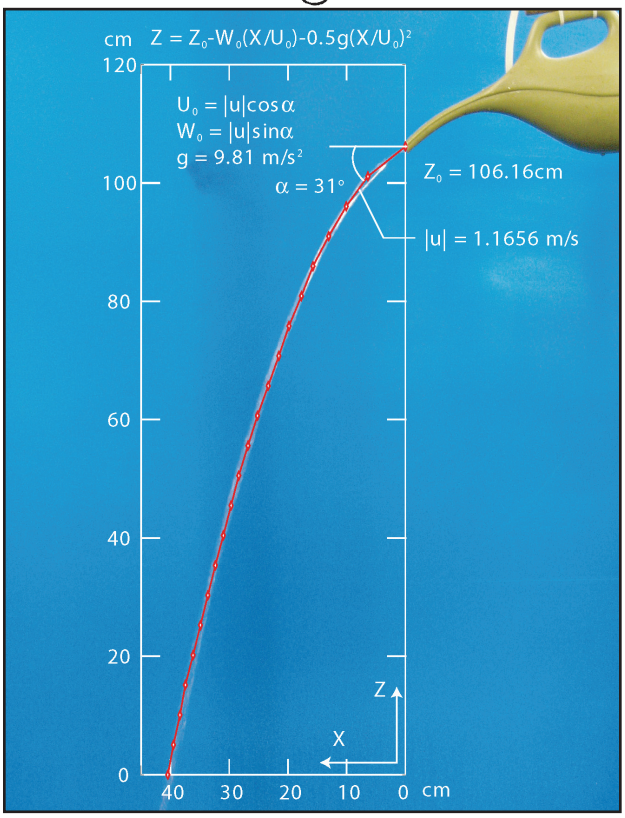
Several participants described current training programs and practices available from their respective organizations. In addition, NCED presented a plan for developing a Masters-level degree program in applied stream restoration. Although these resources are available, most participants felt there were still major shortcomings. There was general agreement that an attempt should be made to put a template on the table for discussion, that some degree of coordination is desirable, and that the government agencies represented would be willing to share what training materials and methods they have. There was also agreement that the same gaps identified above for stream restoration practice (lack of interdisciplinary approach, "reach scale" thinking) are clearly present in the training as well.

NCED Roles in Restoration

Participants identified several ways in which NCED, as a national science center, could make material contributions to the stream restoration community: (1) Research – NCED is already doing much basic research and is committed to transferring that knowledge to the practitioner community. In addition, NCED could sponsor "working groups" that address specific and difficult restoration science issues, and bring practitioners and scientists together to set a restoration research agenda. (2) Community building – NCED suggested that it would foster communications between all elements of the restoration community through development of a community web space and publication of a newsletter. (3) Training – NCED could provide a valuable service by coordinating the development of training curricula and standards, and helping to insure that these curricula and standards are frequently updated as advances are made in restoration science.

—Michael Kelberer

Anatomy of a Pour ART MEETS SCIENCE



Northern Clay commissioned a SAFL team to calculate the parabolic arc of a pour for an exhibition catalog.

In the experiment illustrated here, University of Minnesota Civil Engineer Professor Gary Parker and graduate students Miguel Wong and Wonsuck Kim measured the water discharge (volume of water per unit time) flowing out of the watering can and secured that such water discharge was kept at a constant value. In this way, they held both the flow velocity at the point of falling water, as well as its angle with the horizontal, constant. Having the value of the initial velocity (U = Q / A; where Q = water discharge, and A = cross-sectional area) and its angle with the horizontal (α), you have everything you need to simulate the trajectory of pouring water.

The SAFL generated image and calculations were used in the catalog produced for the exhibition *The Social Life of Pouring Pots*, which will run through May 8th at the Northern Clay Center, 2424 Franklin Avenue East, Minneapolis.

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