USP-SC & CSUF:
An Ongoing Graduate Teaching And Research Collaboration Experience

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SulAmérica Convention Center
Rio de Janeiro, Brazil

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Graduate Program in Applied Mathematics (GPAM)

USP, Instituto de Ciências Matemáticas e de Computação (ICMC)
Centro de Ciências Matemáticas Aplicadas à Indústria (CeCMEAI)

Collaboration Experience, Challenges, and Future Direction
The California State University (CSU) is a public university system in California. With 23 campuses enrolling 478,638 students with 24,405 faculty and 23,012 staff. CSU is the largest four-year public university system in the United States.
• CSUF is the largest among the 23 campuses in the CSU system (40,400 students)
• 5800 graduate students (largest in the CSU)
• 2,083 faculty (782 tenure track)
• 109 degrees: (57 baccalaureate + 52 graduate)
• Largest Math Dept. in the CSU system
• Faculty of 100+ (46 full-time and 60+ part-time instructors)
• 5 concentrations (Actuary Sci., Applied, Pure, Stats, Teaching)
• 200+ undergraduate students
• 150+ graduates students
• Masters of Arts
• Founded in 1986
• 8 Tenure-track Professors
• ~40 students
• Unique Industrial Capstone/Project
Recent Industrial Projects

GE Healthcare

NASA

JPL

ESA

AEROSPACER

ThalesRaytheonSystems

SPECTRAL IMAGING LABORATORY

SPILAB

L3

CeMEAI

CEPID - Center for Mathematical Sciences Applied to Industry

BOEING

Internationalization and Research Challenges and Strategies
APRIL 14-18 - Rio de Janeiro - Brazil

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Recent Industrial Projects

1. The Mathematics of Imaging Blood Flow & the HYPR algorithm, **GE Healthcare**, Madison, WI, USA
3. The pore pressure regime of the northern Gulf of Mexico: Geostatistical estimation and regional controls, **Earth Science Associates**, Long Beach, CA, USA
5. Astrodynamics for a Constellation of CubeSats near the Earth-Moon Lagrangian Point, **NASA/JPL**, Pasadena, CA, USA
6. Earlier Cyclone Track Prediction through Analysis of Tropical Disturbances, **Earth Science Associates**, Long Beach, CA, USA
7. Risk Assessment for DOD Acquisition Using Machine Learning Algorithms, **Aerospace Corporation**, El Segundo, CA, USA
8. Fast Iterative Techniques for Tomographic Image Reconstruction with Applications in MRI, PET, and CAT scans, **University of Sao Paulo**, Sao Carlos, Brazil
9. Advanced Signal Processing Techniques to Avoid Signal Jamming and to Evade Signal Telegraphing, **Intelligent Fusion Technology**, Maryland, USA
10. Optimizing satellite communication networks in the event of natural and adversary disasters, **Aerospace Corporation**, El Segundo, CA, USA
Industrial Capstone Projects

1. ~$25,000 USD per project
2. A team of 4 to 7 students + Professor
3. Develop August – December
   a) Statement of Work
   b) Related disciplines
   c) No black-box projects (Publishable only)
   d) Deliverables (Technical report, presentation, code)
   e) Prep students
4. Execution January - April
5. Deliver May
Industrial Project Benefits

1. Provide hands-on experience training to students
2. Enhance student employment opportunity after graduation
3. Serve as a good recruiting opportunity for industrial sponsors
4. Increase potentials for admitting to outstanding PhD programs
5. Professor receives 3 units of teaching release for every funded project
6. Fund program-related activities for faculty & students
Mission

Working as an interlocutor between academia and industry/government aiming at solving challenging industrial problems by applying techniques from the mathematical sciences.
Mathematics Context

World Recognition

Group V

Group IV

Only Mathematics in Brazil won a Fields Medal or Nobel Prize

Center for World University Rankings

10th Best Institution in Applied Mathematics

<table>
<thead>
<tr>
<th>World Rank</th>
<th>Institution</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pierre and Marie Curie University</td>
<td>100.00</td>
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<tr>
<td>2</td>
<td>Dalian University of Technology</td>
<td>96.64</td>
</tr>
<tr>
<td>2</td>
<td>Fudan University</td>
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<td>Shanghai Jiao Tong University</td>
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<td>University of Sao Paulo</td>
<td>94.30</td>
</tr>
</tbody>
</table>
International Centers
Team

Principal Investigators: 30
Associated Investigators: 56
Post Docs: 40
Ph.D.'s: 181
Managerial & Technical Staff: 4
Students: 181
Main Areas of Research

Applied Optimization and Operations Research
- Cutting and Packing
- Inverse Problems
- Integration of Problems
- Product Planning

Computational Fluid Mechanics
- Numerical simulation of complex flows
- Visual and geometric processing
- Time varying big data visualization

Risk Assessment
- Functional data modeling
- Statistical Quality Control
- Regression Models
- Time series
- Complex systems
- Classification and Categorical Data Analysis
- Survival Analysis
- Data mining
- Meta-learning
- Machine learning
- Data stream mining
- Robotics

Computational Intelligence and Software Engineering
- Bayesian Inference
- Item Response Theory
- Item Response Theory
Study Groups with Industry & Modelling Camps
Meetings and Workshops with Industry
Post-Grad Course - MECAI
Industry

- Wood Quality Detection
- Diapers Production
- Irregular fabric cutting
- Operation of the city’s plumbing system
- Ship routing and scheduling in oil industry
- Large Eddy Simulations of Supersonic Jet Flows
- Production planning problem in small foundries
- Production Planning in Chemical Industry
- Enhance the efficiency of cutting stock for furniture production
- The use of wavelets for analyzing time-varying data
Finances

- Adaptive Algorithms in Accelerometer Biometrics
- Fraud detection on Credit Card Transactions
Health

- Stress-o-meter
- Epidemic Control
- Mapping Gene Correlation
- Schizophrenia diagnosis
- Neglected Tropical Diseases (Chagas & Malaria)
- Risk Analysis in Labor
- Elderly monitoring (Fall prediction)
- Tinnitus
- Insect Identification (Aedes Aegypti)
- Propagation of rumors and epidemics
- Numerical Modeling in Viscous Lipidic Membranes
Technology

- Molecular Dynamics Simulations
- Uses of Beacons
- Fast Iterative Tomographic Reconstruction
- Spectral Image Segmentation
Sports

- Talents Prediction
- Sports Prediction
Sustainability

- Auto Detection of Water Leaking
- Residue management solution
Agribusiness

- Use of Drones in agriculture
- Real-Time control models for Broiler Production
- Water Quality monitoring
• Gamified peer assessment model for on-line learning environments
• Online Evaluation System
Knowledge Transfer

- 2 Spin-Offs
- 1 PIPE Project
- 4 Pending Patents
- 16 Software
- 10 Industrial Agreements
- US$ 2.4 million
How the Collaborations got started?

During a 2015 NAFSA Meeting, a CSUF team, led by Dr. Kari Knutson-Miller, Vice President of the International Programs and Global Engagement, visited ICMC for possible institutional collaborations.
How the Collaborations got started?

• A CSUF Team of Professors from Mathematics, Engineering, and Computer Science visited ICMC to explore joint research opportunities in May 2016

• An LOI was established in 2016
How the Collaborations got started?

• Professor Jose A. Cuminato (ICMC) visited CSUF and gave a talk to GPAM.

• A Statement of Work Between ICMC & GPAM resulted December 2016.
What USP-GPAM have done up to this point?

Reduced Order Methods in Medical Tomography

Nicole M. Hemming-Schroeder, Charles H. Lee, and Thomas Freeze
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Saifon Chaturantabut
Department of Mathematics and Statistics
Thammasat University, Bangkok Thailand
Experience & Challenges

✓ These activities would not have happened quickly, had there not been high-level initiations, supports, and funding.

✓ Didn’t wait

✓ Both institutional track records are truly helpful for industrial/governmental support

✓ Sustainability

✓ Energized Bunny
Going Forward & Future Plans

1. Exchange program for faculty and students
2. Expose Brazilian students and faculty to US industrial projects
3. Continue & Expand Joint Research
4. Possible Joint-degree Program
5. Explore the Optional Practical Training (OPT) Opportunity for Students in the US upon Graduation
Thank you!