

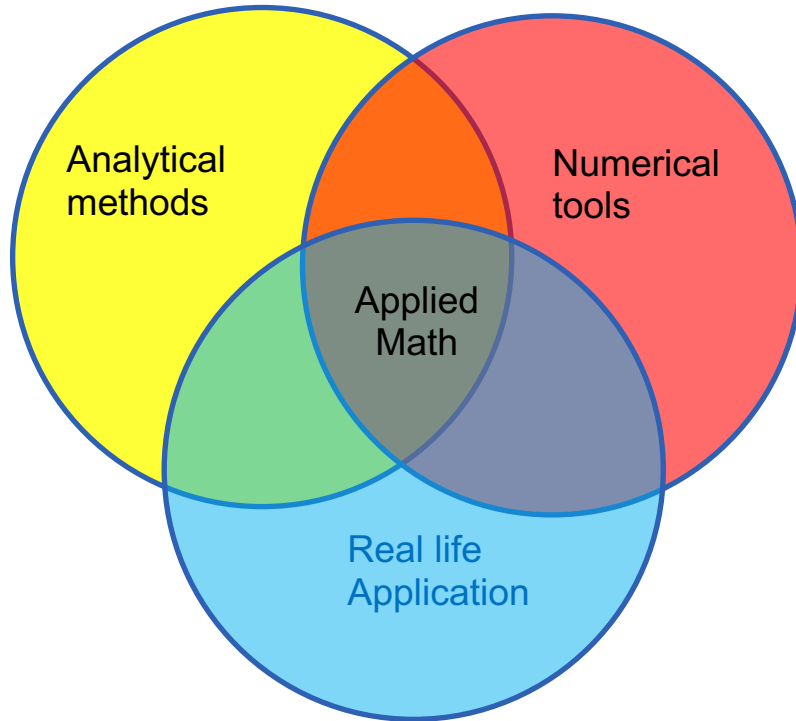


# UCSC Applied Mathematics PhD program

Pascale Garaud (incoming Chair)  
Presentation to ARCS committee



# What is Applied Mathematics (AM)?



**Applied mathematics** is concerned with **creating** and **applying** novel **analytical methods** and **numerical tools** to answer important questions of **real-life significance** in different fields such as physics, finance, engineering, medicine, biology, business, computer science, and industry.

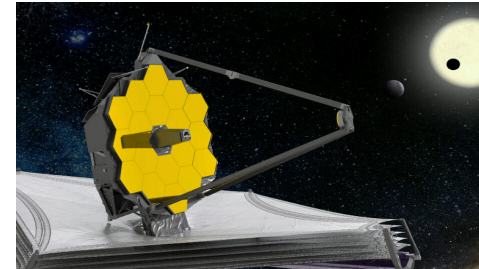
# Research excellence in several areas



Fluid dynamics



Mathematical and computational biology



Control theory

$$|a| = \begin{cases} a, & a \geq 0 \\ -a, & a < 0 \end{cases} \quad u_i = R_i i_j + \sum_{j=1}^{j=2q} L_{i,j} \frac{d i_j}{dt} + \omega \sum_{j=1}^{j=2q} i_j$$

$$(a-b)(a^2+ab+b^2) = a^3 - b^3 \quad \int x^\alpha \cdot dx = \frac{x^{\alpha+1}}{\alpha+1} + c \quad \sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}} \quad \sin \frac{\alpha}{2} \cdot \cos \frac{\alpha}{2} = \frac{1}{2} \sum_{i=1}^n \frac{d L_{i,j}}{d \varphi} \quad \sum_{i=1}^n (x_i - y)^2 \quad (x')^n = n x^{n-1} \quad \frac{\sqrt{a}}{\sqrt{b}} = \frac{\sqrt{a}}{\sqrt{b}} \quad \sin \frac{\alpha}{2} \cdot \cos \frac{\alpha}{2} = \frac{1}{2} \sum_{i=1}^n \frac{d L_{i,j}}{d \varphi} \quad \frac{\pi}{2} - \text{ArcSin}(x) \quad u_i = R_i i_j + \sum_{j=1}^{j=2q} L_{i,j} \frac{d i_j}{dt} + \omega \sum_{j=1}^{j=2q} i_j$$

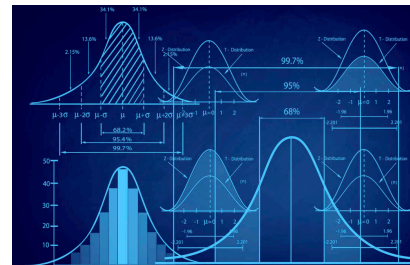
$$y = x \cdot 2 \quad \frac{\pi}{2} - \text{ArcSin}(x) \quad u_i = R_i i_j + \sum_{j=1}^{j=2q} L_{i,j} \frac{d i_j}{dt} + \omega \sum_{j=1}^{j=2q} i_j$$

$$\sin \alpha = 2 \sin \frac{\alpha}{2} \cdot \cos \frac{\alpha}{2} \quad \text{ctg} \alpha + \text{ctg} \beta = \frac{\sin(\alpha + \beta)}{\sin \alpha \sin \beta} \quad x_{1,2} = \dots$$

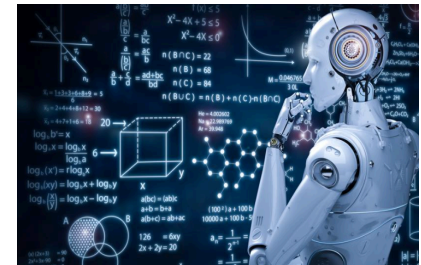
Analytical methods



High-performance computing



Stochastic modeling and uncertainty quantification



Scientific machine learning

# AM at UCSC: a rapidly growing field

Created in 2018, the department now has

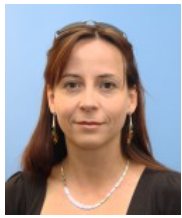
- 9 core faculty (+ 1 or 2 new ones next year)
- 1 emeritus faculty & 3 adjunct faculty (NOAA and NPS)
- 1 Ph.D. degree program (26 students)
- 2 MS degree programs (2+20 students)
- 1 BS program (~ 70+ students), and a 4+1 program into the MS



# Faculty composition, now



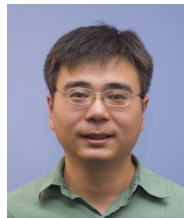
H. Wang  
Math Bio,  
Stoch. Mod.



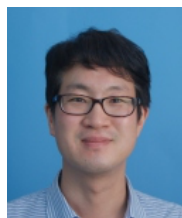
P. Garaud  
Fluids  
Analysis



N. Brummell  
Fluids  
HPC



Q. Gong  
Control  
SciML



D. Lee  
Fluids  
HPC



D. Venturi  
UQ, SciML  
Analysis



M. Gomez  
Math Bio  
Control



A. Halder  
Control  
SciML



V. Jonsson  
Math Bio  
SciML



S. Munch (NOAA)  
Math Bio,  
Stoch. Mod.



F. Giraldo (NPS)  
Fluids  
HPC

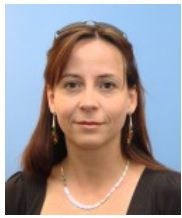


W. Kang (NPS)  
Control  
SciML

# Faculty composition, now and in the future



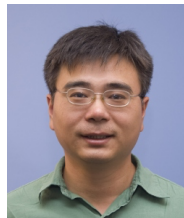
H. Wang  
Math Bio,  
Stoch. Mod.



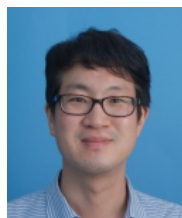
P. Garaud  
Fluids



N. Brummell  
Fluids  
HPC



Q. Gong  
Control  
SciML



D. Lee  
Fluids  
HPC



D. Venturi  
UQ  
SciML



M. Gomez  
Math Bio  
Control



V. Jonsson  
Math Bio  
SciML



J. Gonzalez-Rocha  
Control



A. Chattopadhyay  
SciML



S. Munch (NOAA)  
Math Bio,  
Stoch. Mod.



F. Giraldo (NPS)  
Fluids  
HPC



W. Kang (NPS)  
Control  
SciML

+ 1 more offer has been  
made to junior faculty  
computational genomics

+ 3 more faculty requested in SciML,  
HPC, and control/optimization and  
Lecturer with security of employment.

# Recent Faculty Distinctions & National Offices

Important publications in past 5 years

- 3 Nature journal papers
- 2 Annual review invited papers

- 1 fellow of APS (Garaud, DFD)
- 1 R&D100 award winner (Lee)
- 2 early career awardees (Gomez 2018: DARPA Riser, Jonsson 2018: NIH K12)

- 1 member of APS, 1 member of IEEE, 3 members of SIAM, 2 members of AGU
- Garaud, Halder, Jonsson, Lee and Wang hold editorial posts in international journals.
- Lee is a founding member of the Flash-X code council, and long-term committee member of ASTRONUM
- Garaud is EC member of WHOI GFD summer program.

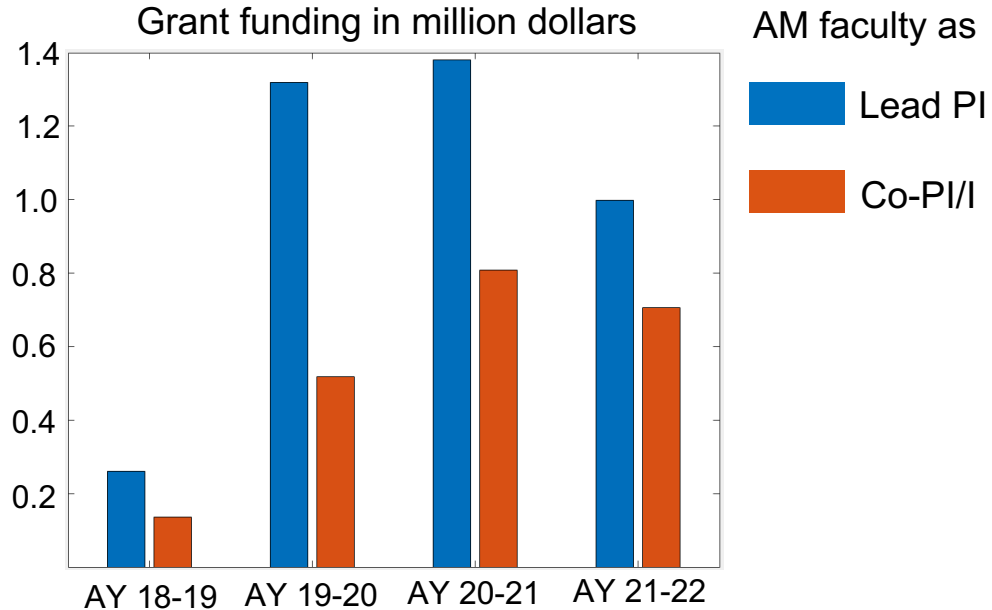
# Fundraising

Grants in AM are sought and awarded from many sources, primarily:

- DOD, DARPA, AFOSR, ARO
- NSF, NASA, NIH
- DOE

Majority of research funds are used towards:

- Faculty summer salary
- Postdoctoral researcher support
- **Graduate student research salary**





# PhD program

- 26 PhD students in Spring 2023 (~ 3 students per faculty)

Current Year	# students
Year 1	6
Year 2	3
Year 3	2
Year 4	4
Year 5	8
Year 6	1
Year 7	2

Subject Area	# Students
Fluid Mech.	5
Control	8
Math. Bio	5
UQ/Stochastic Modeling	4
HPC	4
SciML	0 ... (or many)

# Student funding

**AM PhD students have 5 year guaranteed academic-year funding, with various sources:**

**In AY 22-23 we supported**

- 25 quarters of TAships
- 24 quarters of GSRships
- 11 quarters of fellowships
- 2 quarters of GSI

**(students on part-time status, or LOA, are not funded by the department)**

## GSR

- Directly funded by PI grants
- From AM and other departments (e.g. ECE, OCEAN, AST, etc.)

## Teaching

- TAships
- GSIships

## Fellowships from

- Federal institutions (NSF, NASA, DOE, NOAA, ...)
- UCSC (Cota Robles; Chancellor and Dean's fellowships; dissertation year fellowships)

# Student success

## Professional Development for Academia:

- TA training
- Training by advisor

## Mentoring in Research:

- 1-on-1 meetings with faculty advisor
- Group meetings
- PhD committee meetings

## Student Well-Being:

- Holistic advising
- Cohort-building activities
- Peer advising (to be introduced)

## Professional Development for Industry:

- 3 career development workshops per year
- Alumni network

# Recent distinctions

Dissertation-Year Fellowship, UCSC  
Tenavi Nakamura-Zimmerer (2021-22)  
Anuj Kumar (2022-23)

Cota-Robles Fellowships, UCSC  
Lu Long,  
Martin Ramirez,  
Giovanni Marquez,  
Cynthia Ramirez

NASA Pathway fellowship  
Tenavi Nakamura-Zimmerer (2020-21)  
Chris DeGrendele (2022-23):

Newkirk fellowship (HAO/UCAR)  
Bhishek Manek (2020-21)

Crighton Visiting Fellowship (U. Cambridge)  
Anuj Kumar (2023)

NOAA Sea Grant Fellowship  
Bethany Johnson (2019-20)

# Recent alumni

Dr. Sara Nasab (Fluids, 2021):  
Johns Hopkins Applied Physics  
Laboratory

Dr. Youngjun Lee (HPC, 2021):  
Argonne National Laboratory

Dr. Bhishek Manek (Fluids, 2021):  
Postdoc, CU Boulder

Dr. Tenavi Nakamura-Zimmerer  
(Control, 2022):  
NASA

Dr. Kenneth Caluya (Control, 2022):  
Postdoc, UC Santa Barbara

Dr. Bethany Johnson (Math. Bio., 2022)  
Asst. Prof. Cal. Poly Humbolt.

Soon-to-be Dr. Anuj Kumar  
Visiting Asst. Prof. UC Berkeley

# ARCS partnership

Becoming ARCS-affiliated program would provide invaluable support to our program in areas of most need:

Unrestricted \$10,000 scholarship would be particularly helpful for students living in (very expensive) Santa Cruz.

- ARCS alumni network will
- Increase our students' professional network
  - Provide inspiration for interdisciplinary projects