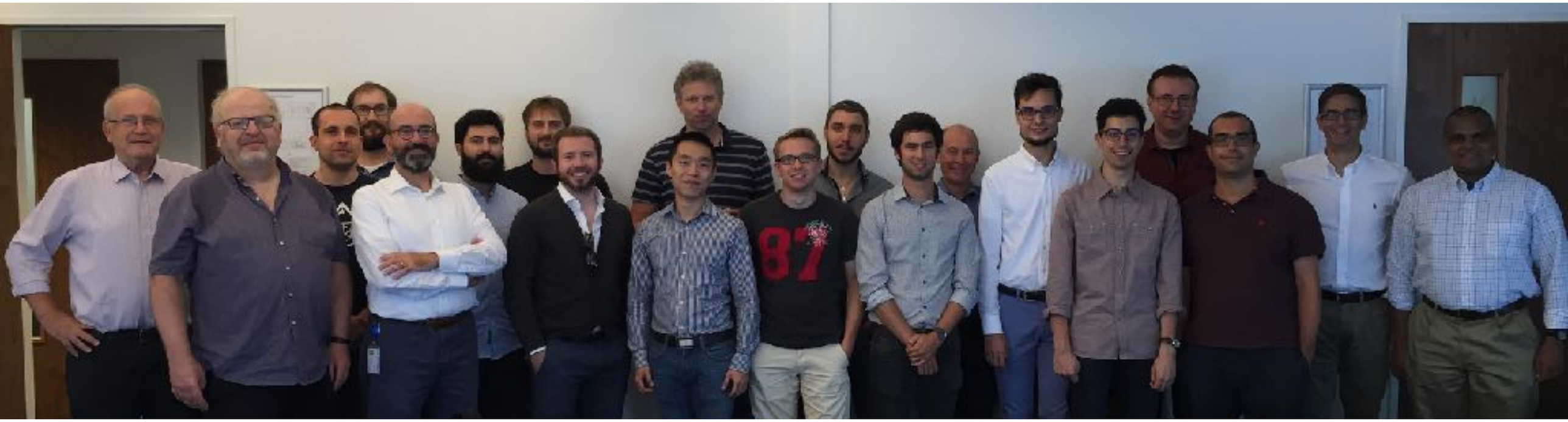
Welcome & Year in Review

Prof. Juan J. Alonso, Dr. Thomas D. Economon, and Dr. Francisco Palacios

2nd Annual SU2 Developers Meeting
Stanford University
December 18, 2017

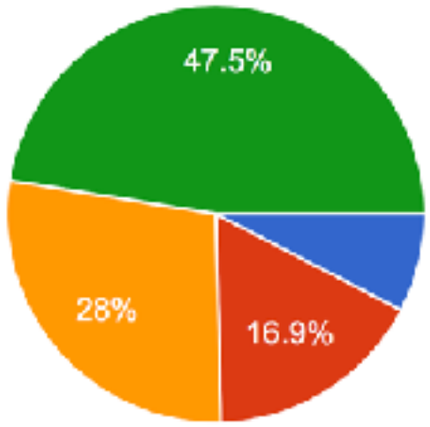
Welcome Developers!



1st Annual SU2 Developers Meeting, September 2016, TU Delft

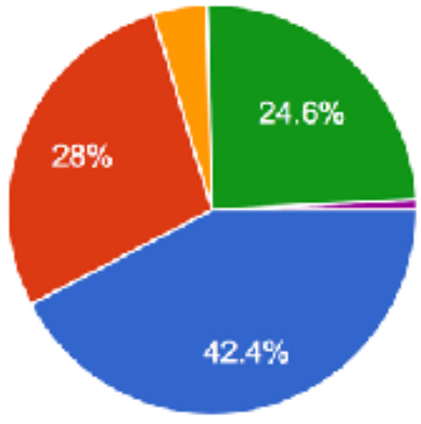
Welcome to the Meeting - Demographics

Years of CFD Experience



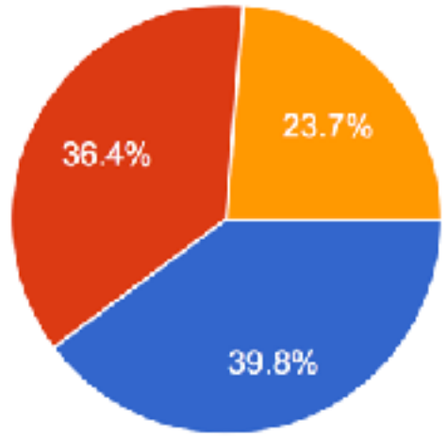
< 1 Year	9	7.6%
1-2 Years	20	16.9%
2-5 Years	33	28%
5+ Years	56	47.5%

Affiliation



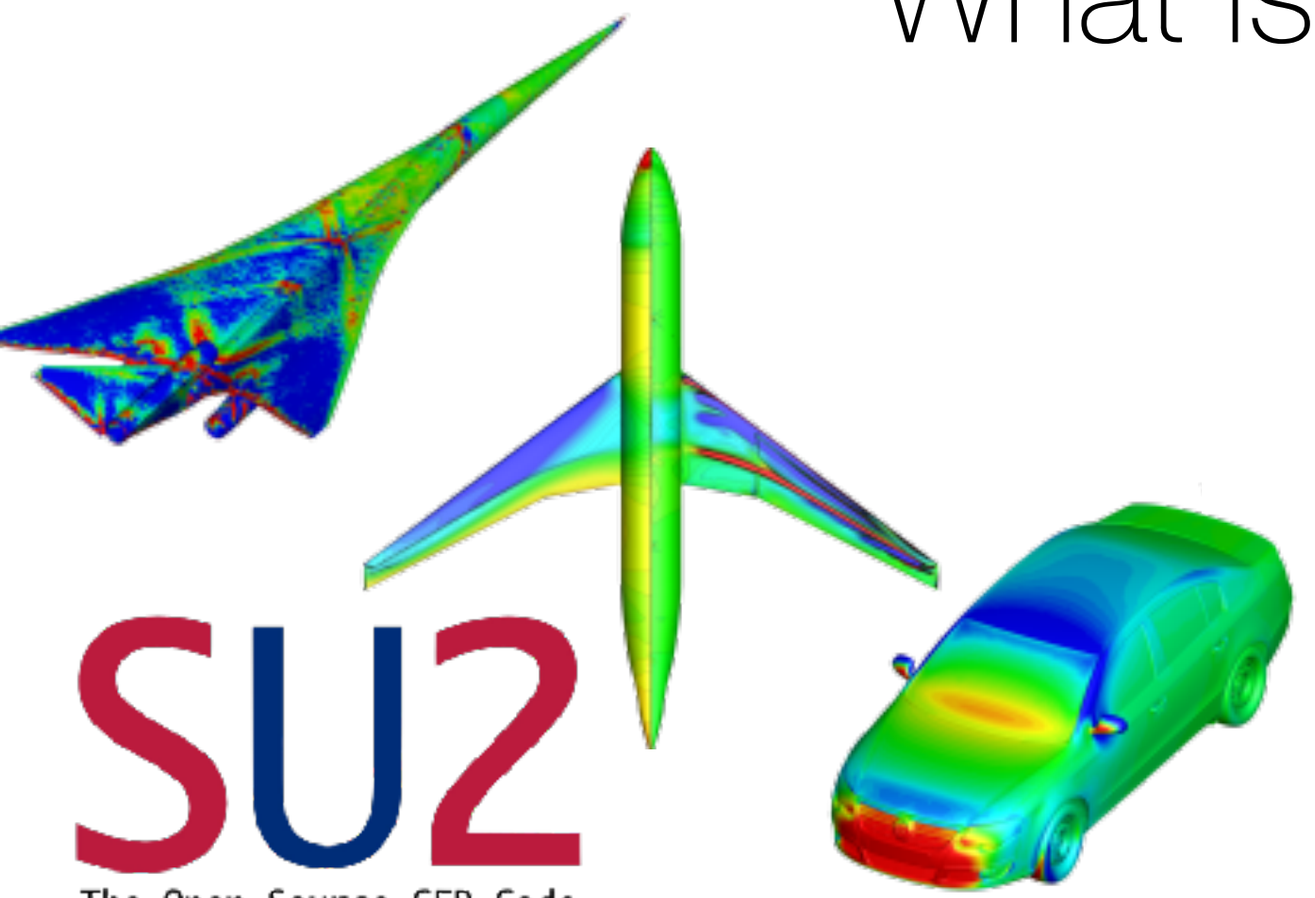
Academia	50	42.4%
Industry	33	28%
Government	5	4.2%
Student	29	24.6%
Other	1	0.8%

How familiar are you with SU2?



Developer	47	39.8%
User	43	36.4%
Have not used SU2	28	23.7%

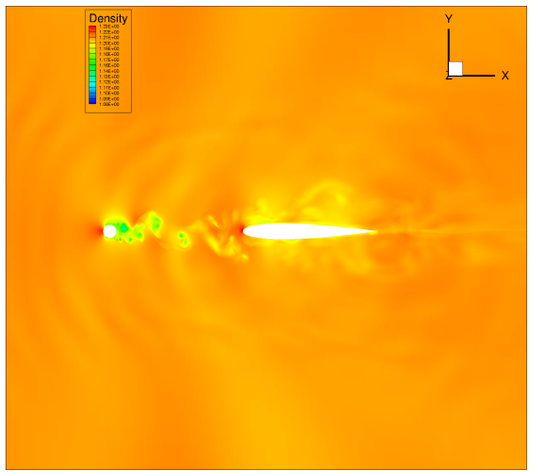
What is SU2?



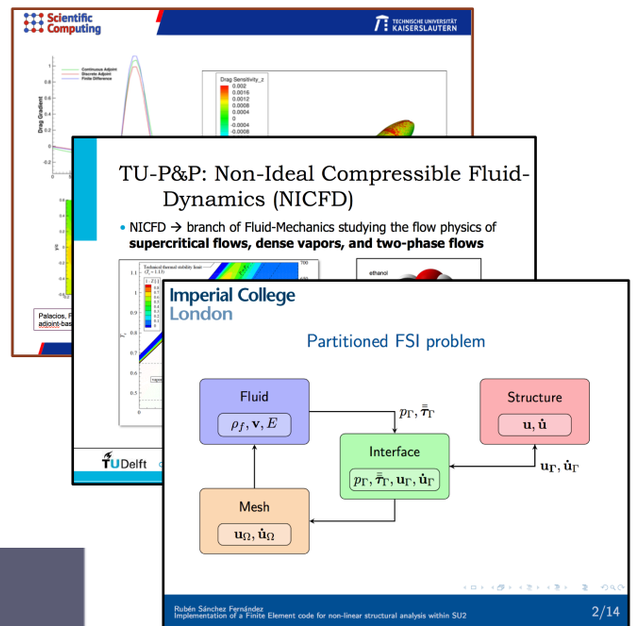
- SU2 is an open-source software package for **multiphysics analysis and design**. Gradient availability through adjoints.
- Research platform for CFD, multiphysics, adjoint methods, HPC, and more. **Reusability**, **readability**, **portability**…
- Software released as **open source** under the LGPL 2.1 license. Available **freely** on GitHub.
- C++/MPI core with a Python layer for automation (~250k lines of code, **HPC-ready**).
- Initial v1.0 release in Jan 2012, latest v5.0 released Jan 2017.

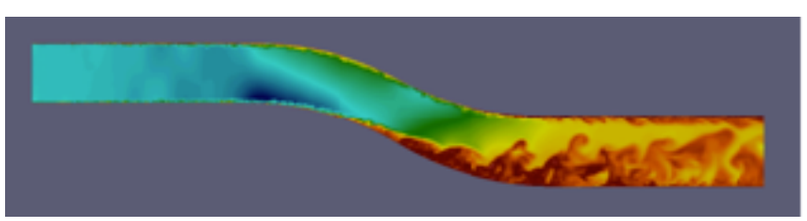
https://github.com/su2code/SU2

https://su2code.github.io



DDES+FWH





DG-FEM Higher-order Solver

SU2 and the NASA CFD Vision 2030 Study

- **Emphasis on physics-based, predictive modeling**

  Transition, turbulence, separation, unsteady/time-accurate, chemically-reacting flows, radiation, heat transfer, acoustics and constitutive models

- **Management of errors and uncertainties**

  Quantification of errors and uncertainties arising from physical models, mesh and discretization, and natural variability

- **Automation in all steps of the analysis process**

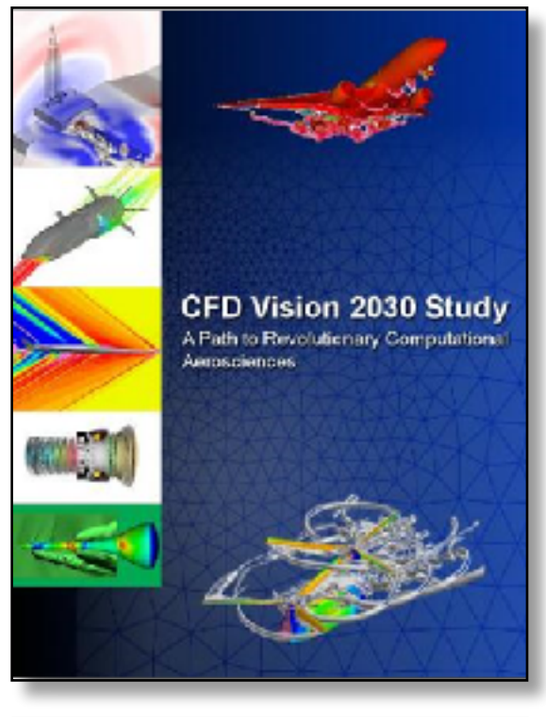
  Geometry creation, meshing, large databases of simulation results, extraction and understanding of the vast amounts of information

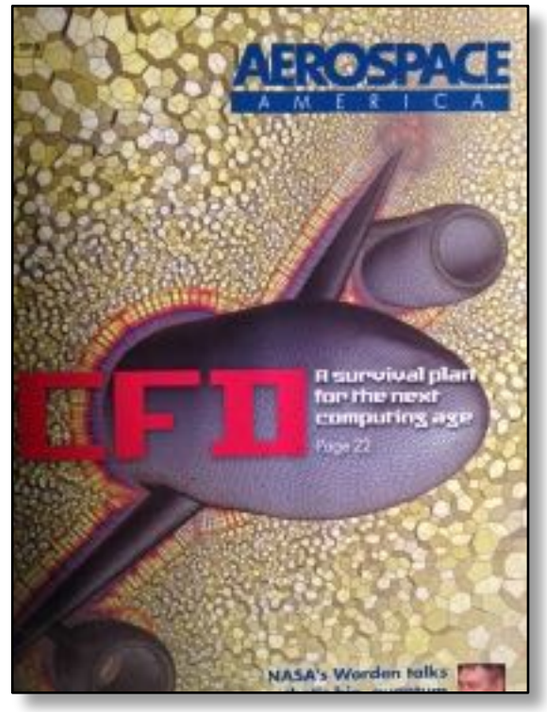
- **Harness exascale HPC architectures**

  Multiple memory hierarchies, latencies, bandwidths, programming paradigms and runtime environments, etc.

- **Seamless integration with multi-disciplinary analyses and optimizations**

  High fidelity CFD tools, interfaces, coupling approaches, the science of integration, etc.





Slotnik, et al., “CFD Vision 2030 Study: A Path to Revolutionary Computational Aerosciences,” NASA/CR-2014-218178, 2014

NASA BOEING

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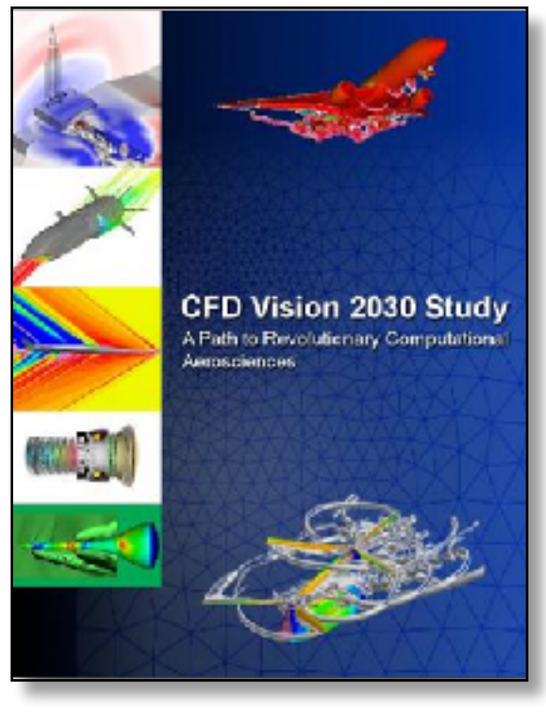
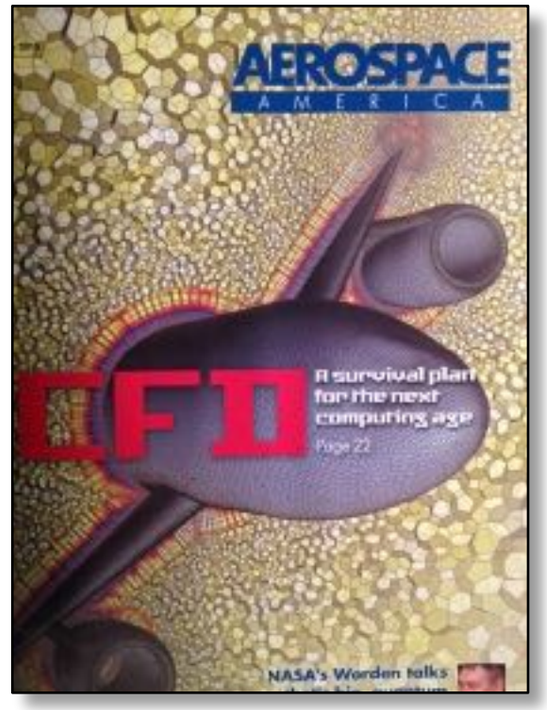




Slotnik, et al., “CFD Vision 2030 Study: A Path to Revolutionary Computational Aerosciences,” NASA/CR-2014-218178, 2014

NASA BOEING

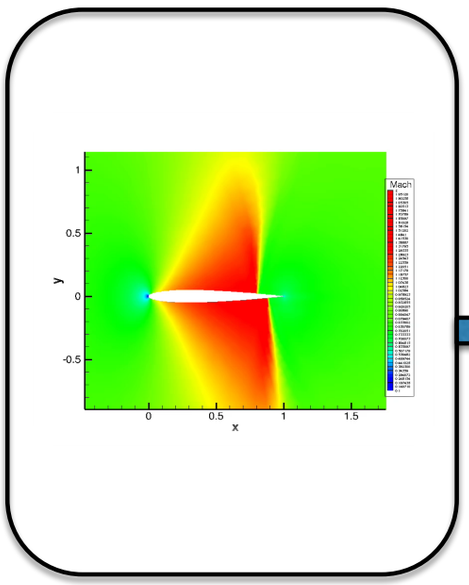
A Global Development Team…

And many others…

One Active Community…

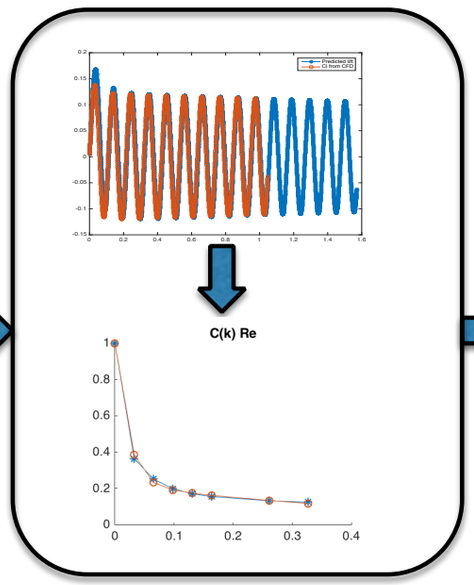
Unsteady CFD to inform lower-fidelity unsteady aero models for flutter prediction

SU2
The Open-Source CFD Code



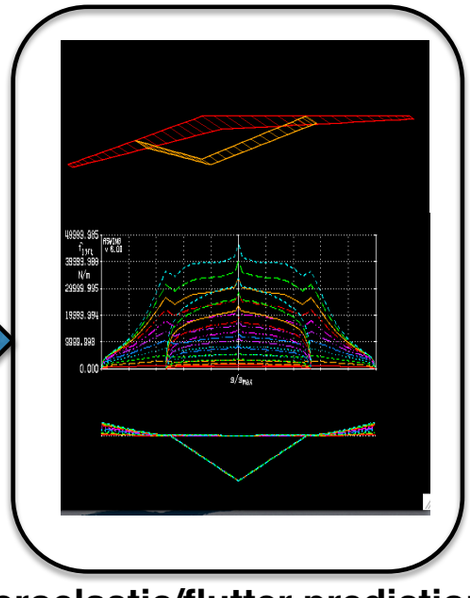
Unsteady pitching/plunging simulation in SU2

Unsteady aero parameters Cl, Cd, Cm over time



Unsteady aero data fit to ROM equations to get model parameters

ROM Model parameters fit to SU2 CFD data



Aeroelastic/flutter predictions in ASWING[1] using CFD based aerodynamic ROM model

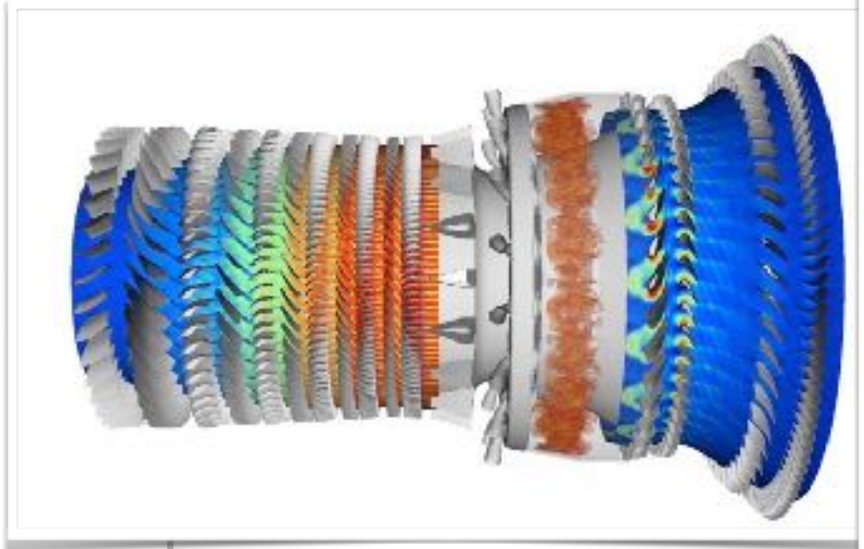
The objective of the work is:

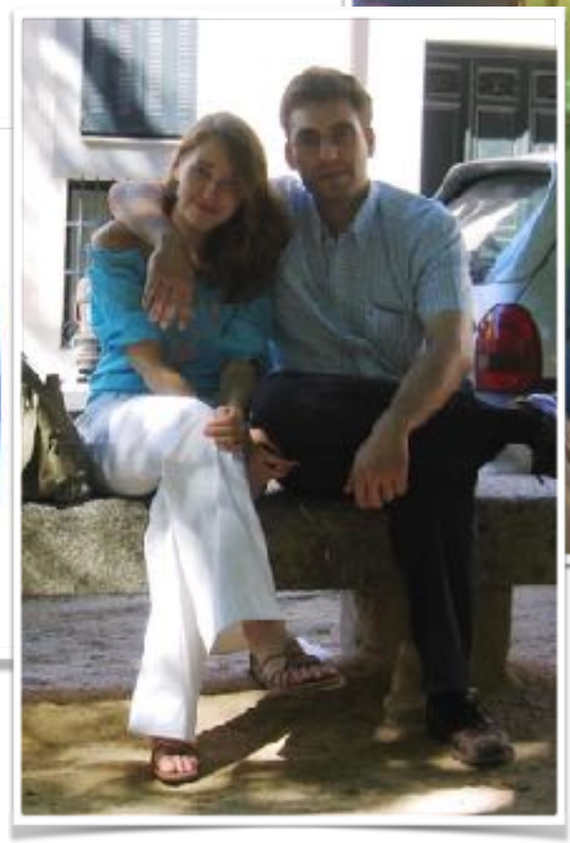
- to improve the accuracy of transonic flutter prediction,
- while maintaining low online computational cost
- for wing/aircraft configurations in conceptual design
- permitting inclusion in a conceptual design/optimization loop

1) Drela, M., “Integrated simulation model for preliminary aerodynamic, structural, and control-law design of aircraft,” 40th Structures, Structural Dynamics, and Materials Conference and Exhibit, AIAA, 1999

aerospacedesignlab

The SU2 Timeline





SUmb solver developed @ ADL

June 2008
Francisco Palacios completes PhD with Juan Alonso on committee

Summer/Fall 2009
Francisco spends 3 months at Stanford

2010
Work on CADES (predecessor to SU2) begins

Jan 2011
Francisco joins ADL @ Stanford

Summer/Fall
Preparations for releasing SU2 as open source

2003-2008

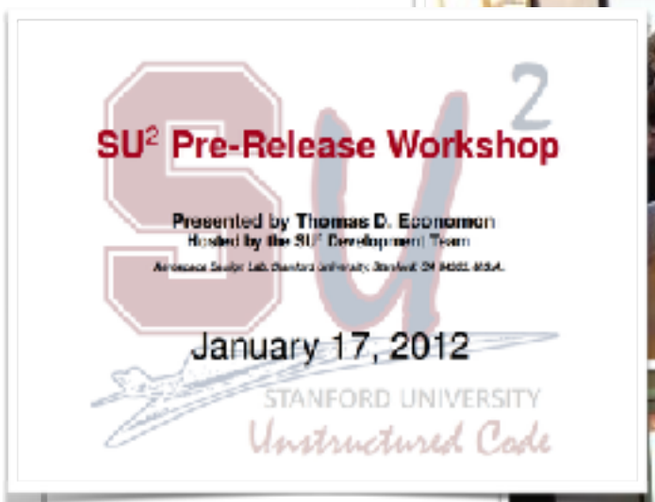
2009

2010

2011

“We must think big... on Jan 20th everybody in the aeronautical community must know that there is a new player in the CFD open-source community.”

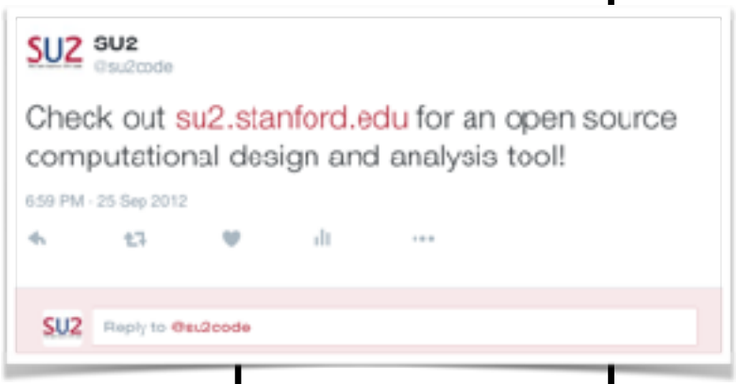
- Dr. Francisco Palacios, January 9 2012



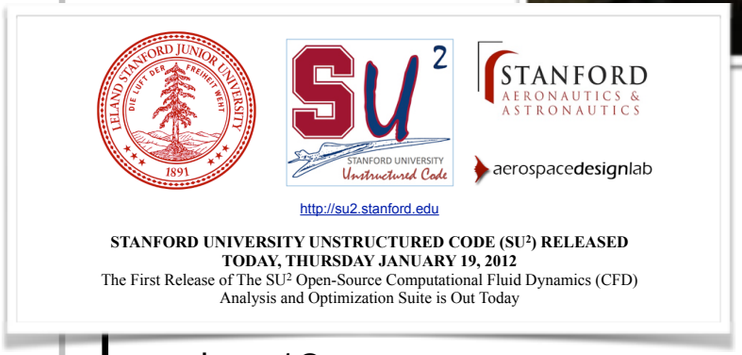
Jan 17
Pre-release
Workshop

Oct 31
su2.stanford.edu update

Jun 25
SU2 v1.1



Sep 25
First tweet
@su2code



Jan 19
SU2 v1.0
SU2 is born!

Winter | Spring | Summer | Fall

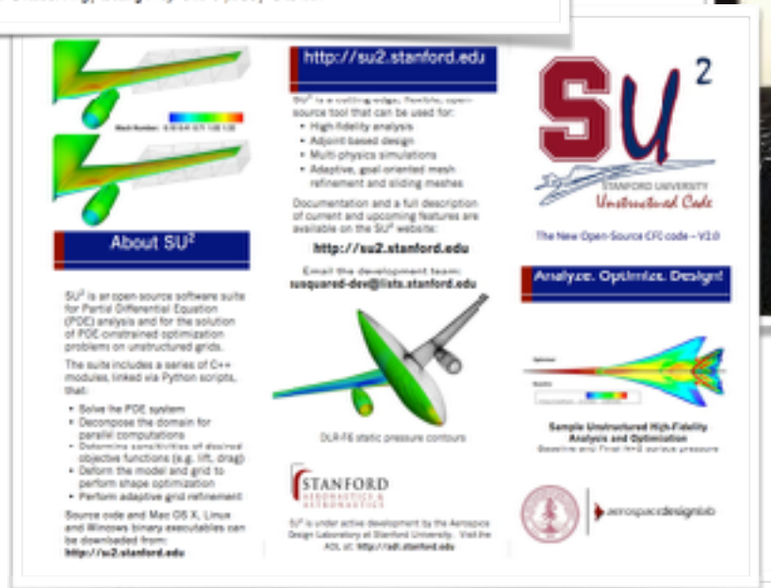
2012

Stanford University Unstructured (SU²): An open-source integrated computational environment for multi-physics simulation and design.

Francisco Palacios*, Michael R. Colonno*, Aniket C. Aranake†, Alejandro Campos†, Sean R. Copeland†, Thomas D. Economon†, Amrita K. Lonkar†, Trent W. Lukaczyk†, Thomas W. R. Taylor†, and Juan J. Alonso‡

Stanford University, Stanford, CA 94305, U.S.A.

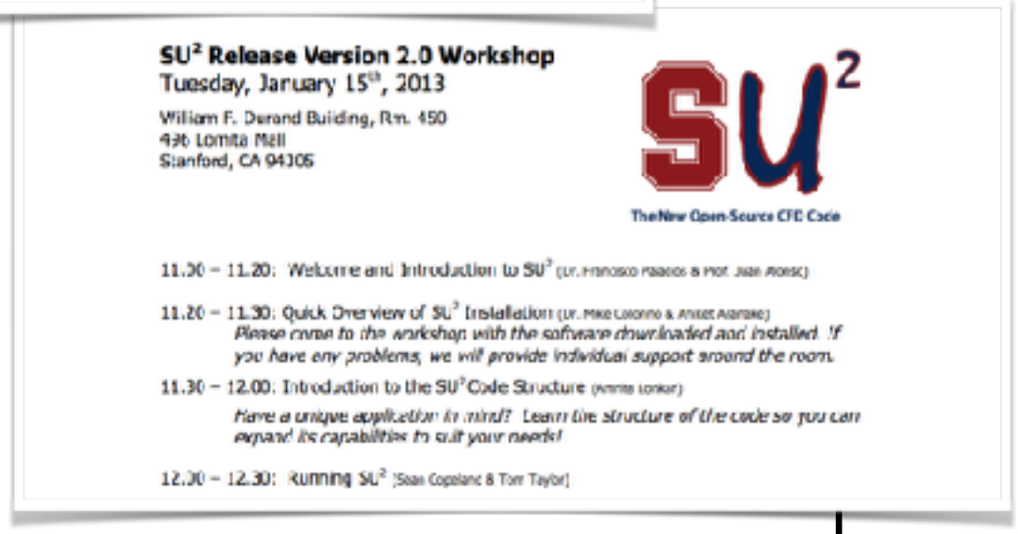
Jan 7
AIAA SciTech
Presentation



May 17 & 25
SU2's first two PhDs

Sep 30
OpenMDAO / SU2
Joint Workshop

Jan 8
SU2 v2.0,
CFD Online
Forum Open



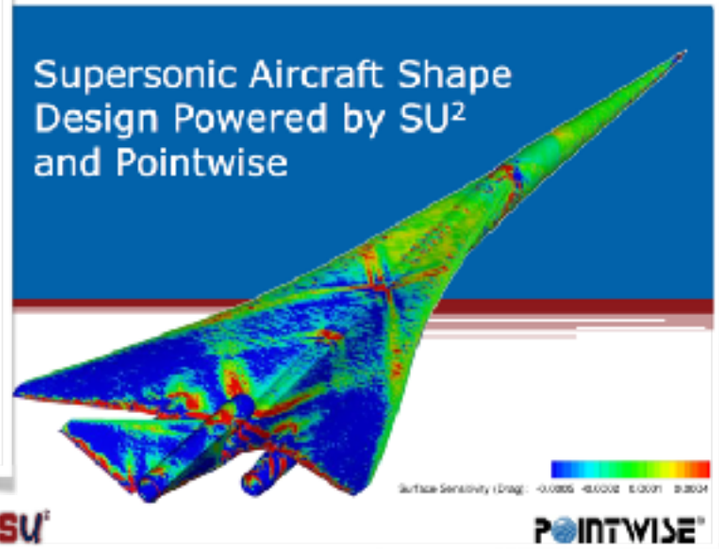
Jan 15
SU2 v2.0
Workshop

Aug 10
SU2 on GitHub

Winter | Spring | Summer | Fall

2013

Jan 15
SU2 v3.0
SU2_EDU v1.0



Apr 29
Pointwise-SU2
Webinar

Apr 14
SU2 v3.1

Jul 29 - New Logo

Jul 31
TU Delft & Polimi
Visit Stanford

May 7
Intel Parallel
Comp. Center

Jun 17
SU2 v3.2

Sep 16
Dev
Email List

Sep 24
“This Week in SU2”
Youtube Season 1
Premiere

Sep 29
Pointwise-SU2
Joint Workshop

Winter | Spring | Summer | Fall

2014

Mar 14
Francisco's farewell
from Stanford

December 29
SU2 in the
AIAA Journal

Wednesday, March 18

MS302
PDE-constrained Optimization using the Open-source Code SU2

2:00 PM - 3:40 PM
Room: 151 AB

Most established codes for PDE-constrained optimization are proprietary, unavailable, or prohibitively expensive for many users. The SU2 code is freely available as open-source and features a complete computational analysis framework for multidisciplinary design in applications such as, but not limited to, aerospace technology. This minisymposium will cover up-to-date topics within the SU2 framework related to its continuous and discrete adjoint capabilities, the application to large-scale aerodynamic design, and the utilization of many-core architectures. Each of the topics covered involve the combination of multiple research areas of interest to the CS&E community.

Mar 18
SIAM CSE
Mini

Jun 23
SU2 v4.0@ AIAA
AVIATION
Travis CI

UNIVERSITY OF TWENTE.

March
TU Kaiserslautern
Visits Stanford

Argonne NATIONAL LABORATORY

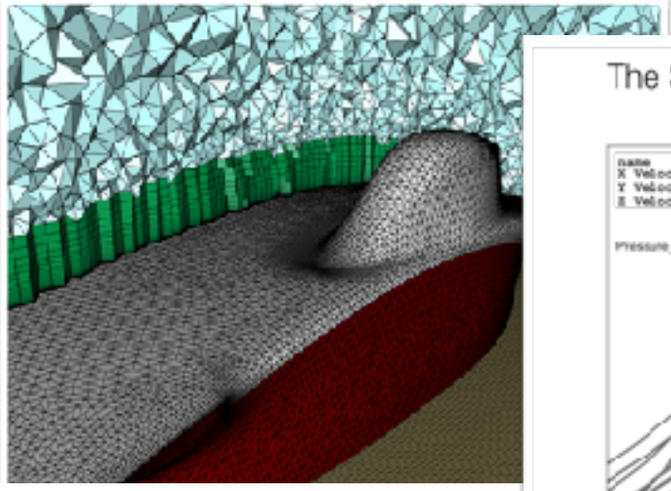
August 6
ALCF Theta
ESP Selection

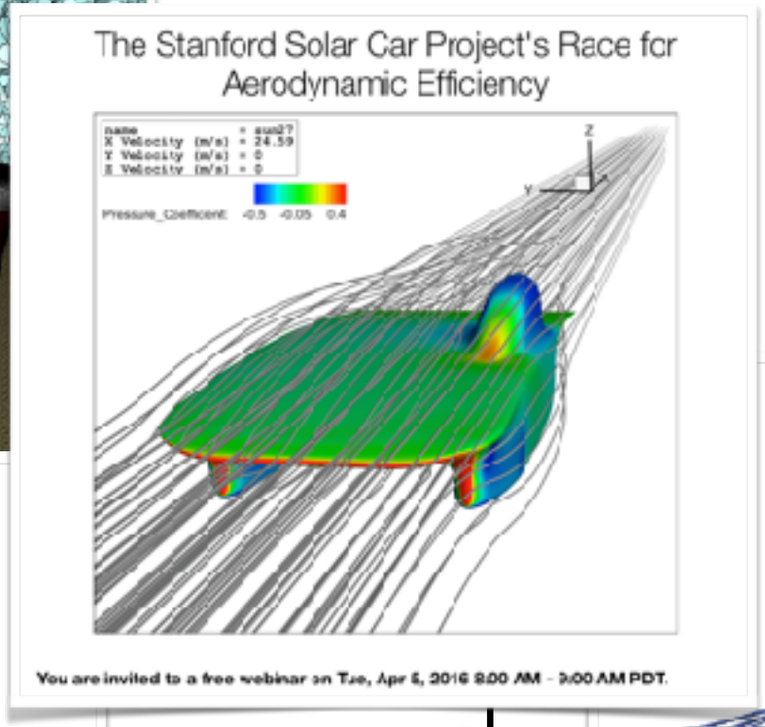
Imperial College London

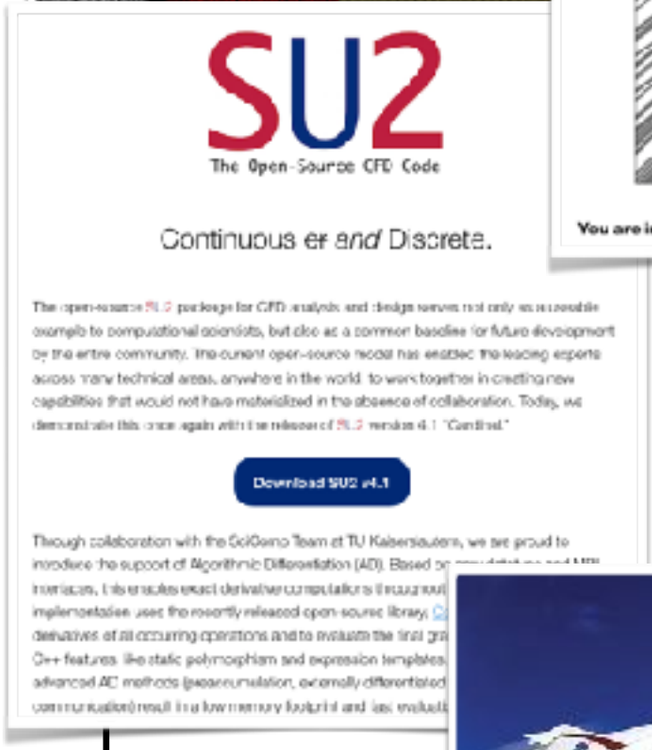
Aug - Sept
Imperial College
Visits Stanford

Winter Spring Summer Fall

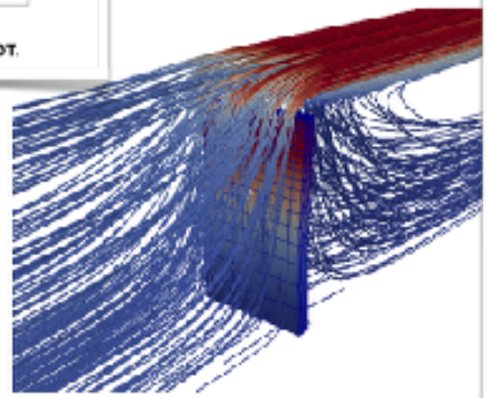
2015







Apr 5
Pointwise,
Tecplot,
SU Solar Car,
SU2 Webinar



Jan 7
SU2 v4.1

Feb 29
NASA LBFD
Announced

Jun 15
SU2 v4.2

Jul / Aug
U of Liege
Visits Stanford

Aug
SU2 v4.3

Sep 5
1st Annual SU2
Developers
Meeting

Winter

Spring

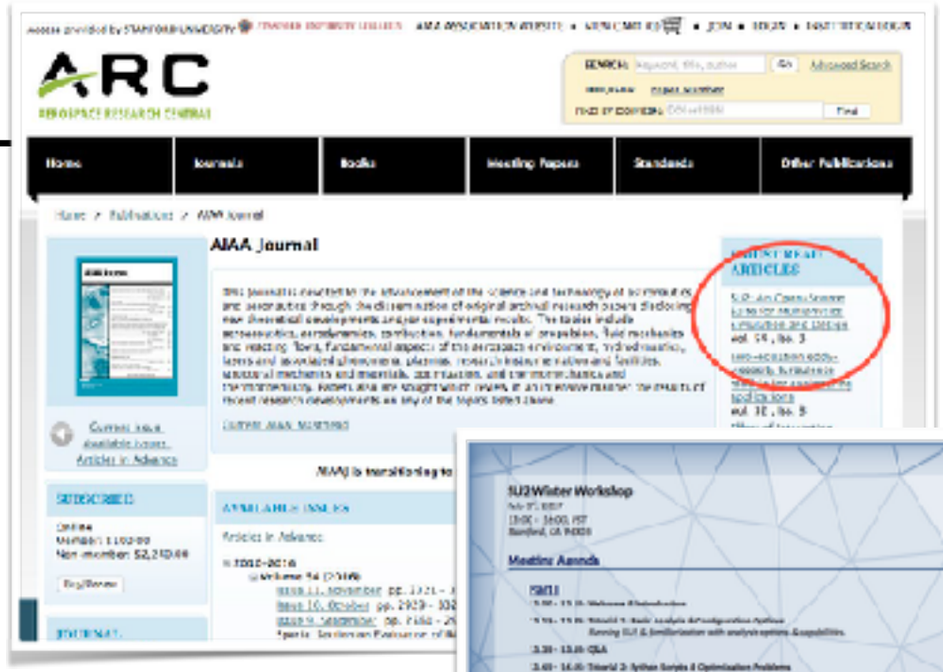
Summer

Fall

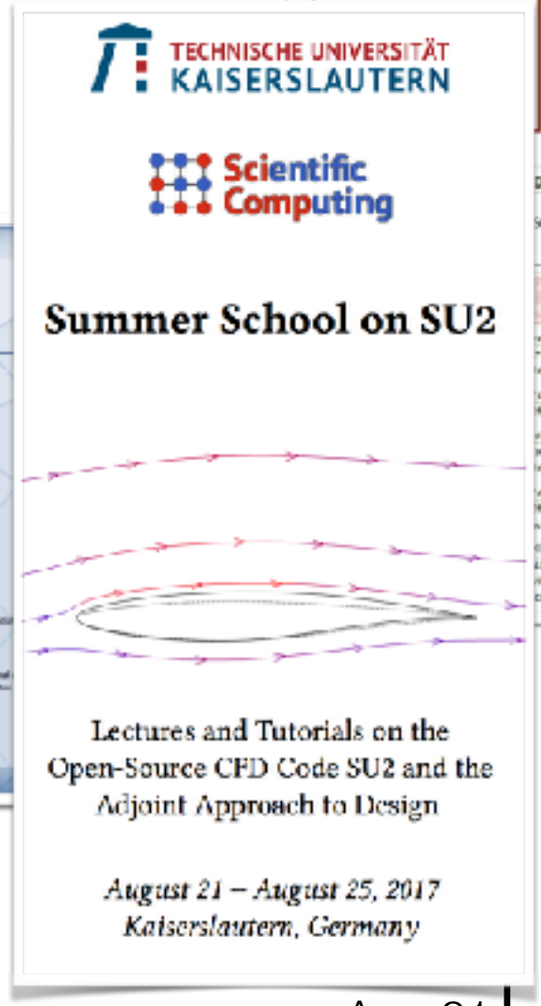
2016

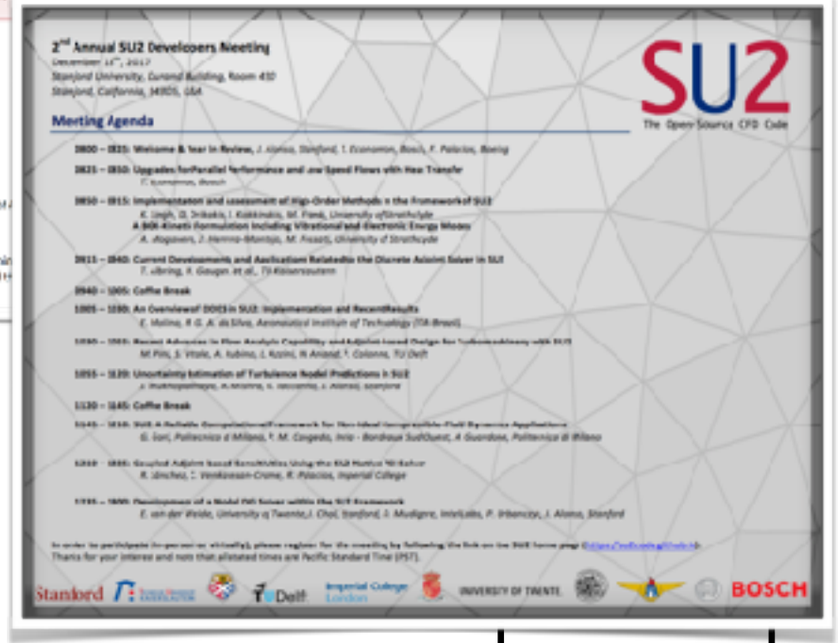
Nov 8 (2016)
SU2 Article Becomes Most Read Paper in AIAA Journal

https://su2code.github.io



Dec1
Open Technical
Call (YouTube)





Jan 19
SU2 v5.0

Feb 3
SU2 Winter
Workshop
@ Stanford

Aug 21
SU2 Summer
School
@ Kaiserslautern

Sep 11
Webpage
Moves
to GitHub

Dec18
2nd Annual
SU2 Dev
Meeting

Winter | Spring | Summer | Fall

2017

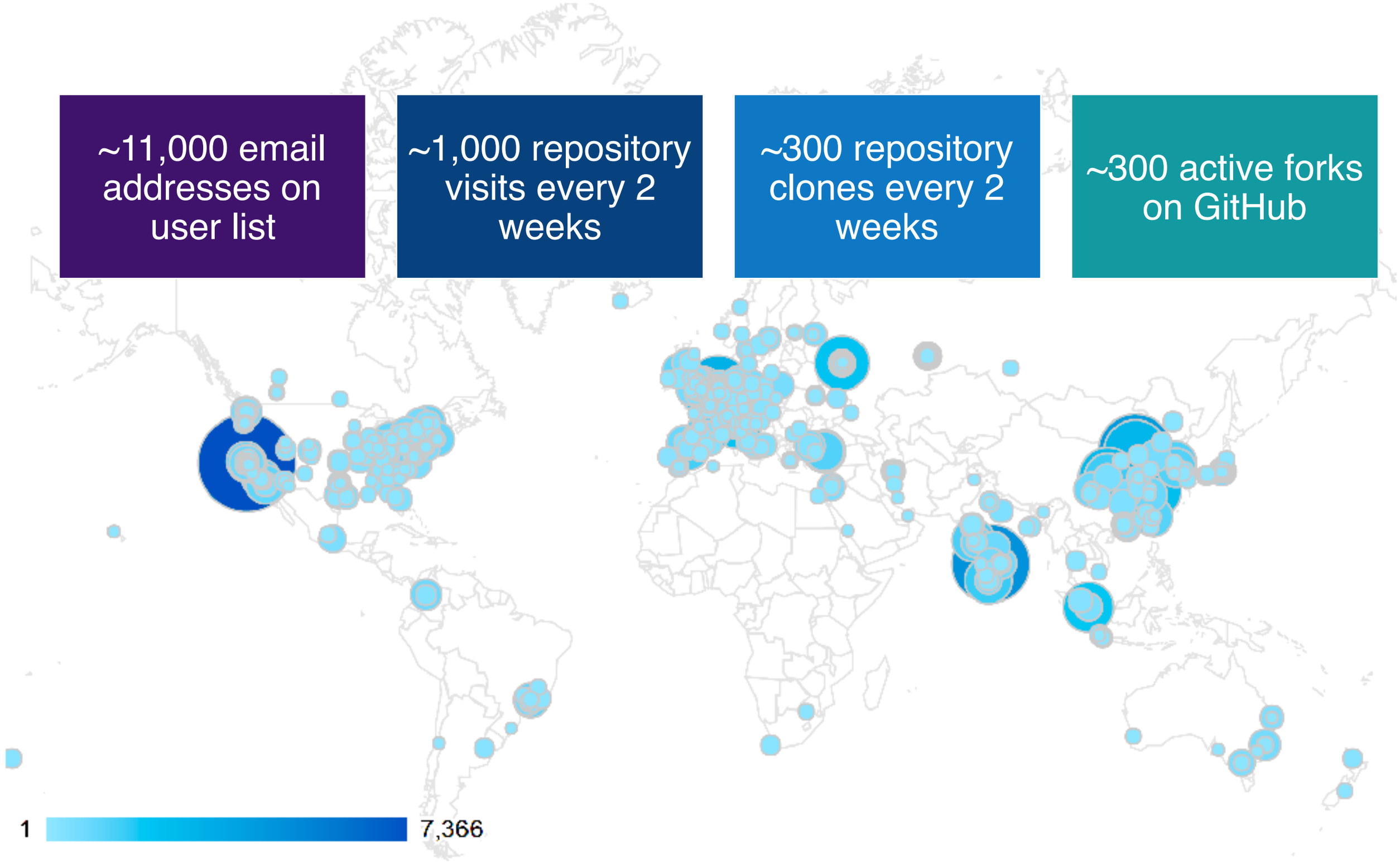
Where are we today? Everywhere.

~11,000 email addresses on user list

~1,000 repository visits every 2 weeks

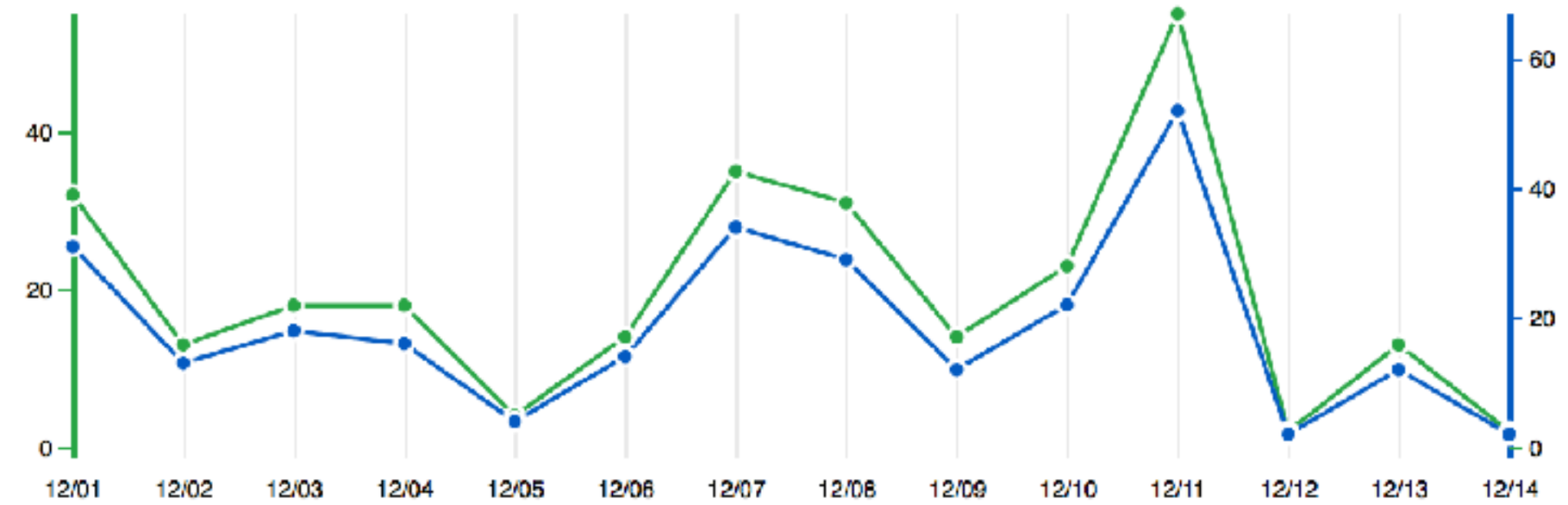
~300 repository clones every 2 weeks

~300 active forks on GitHub



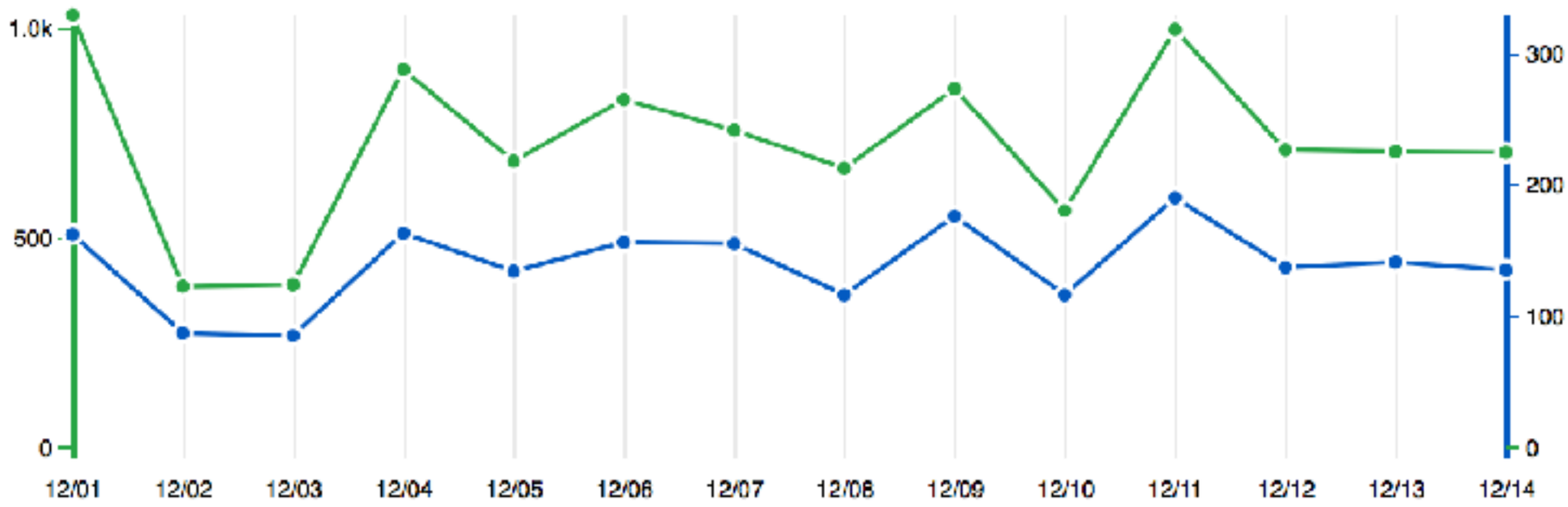
Web hits at https://su2code.github.io by city.

Git clones Traffic data from the SU2 GitHub repository. Accessed 12.14.2017.



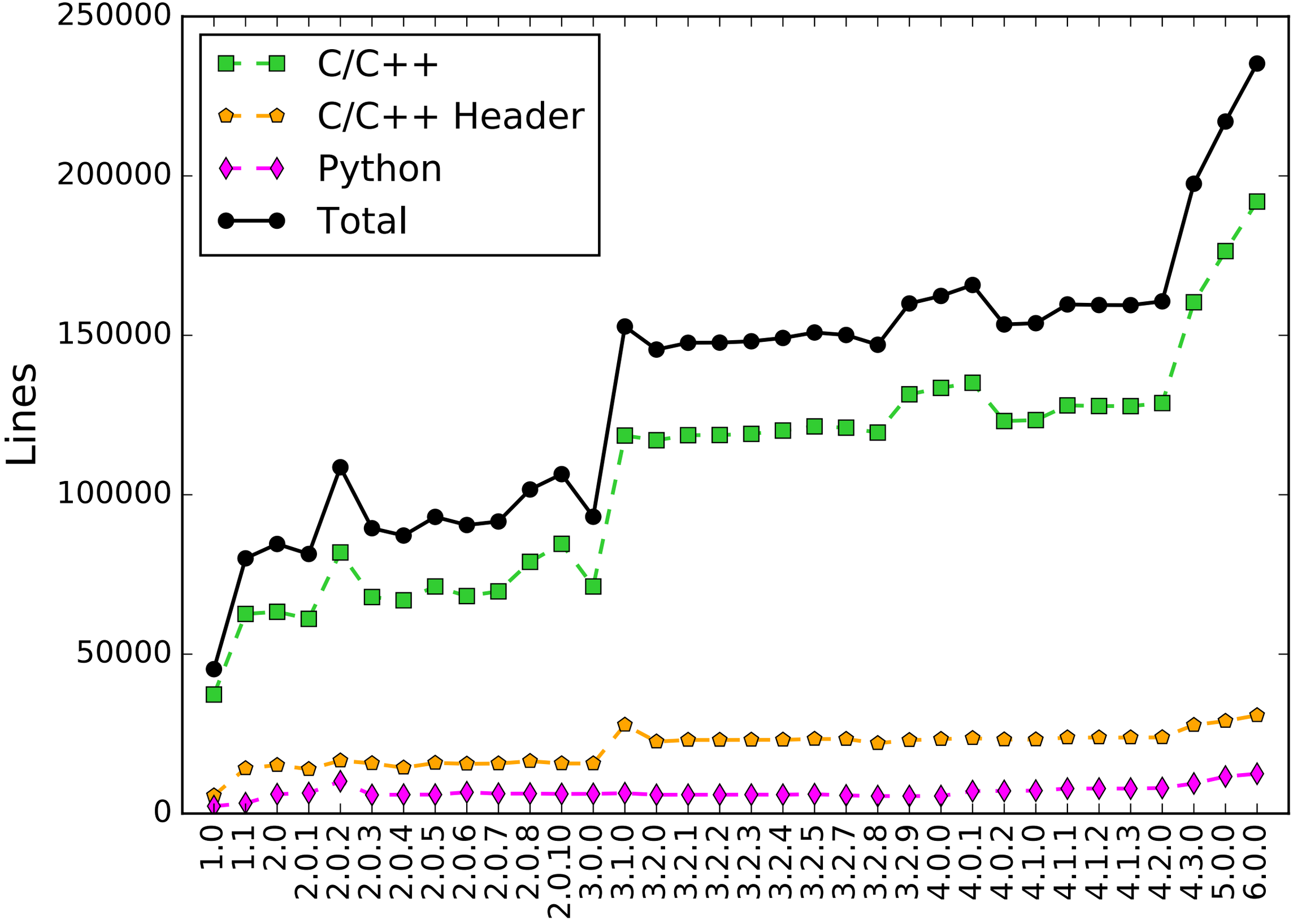
274	254
Clones	Unique cloners

Visitors



10,180	1,484
Views	Unique visitors

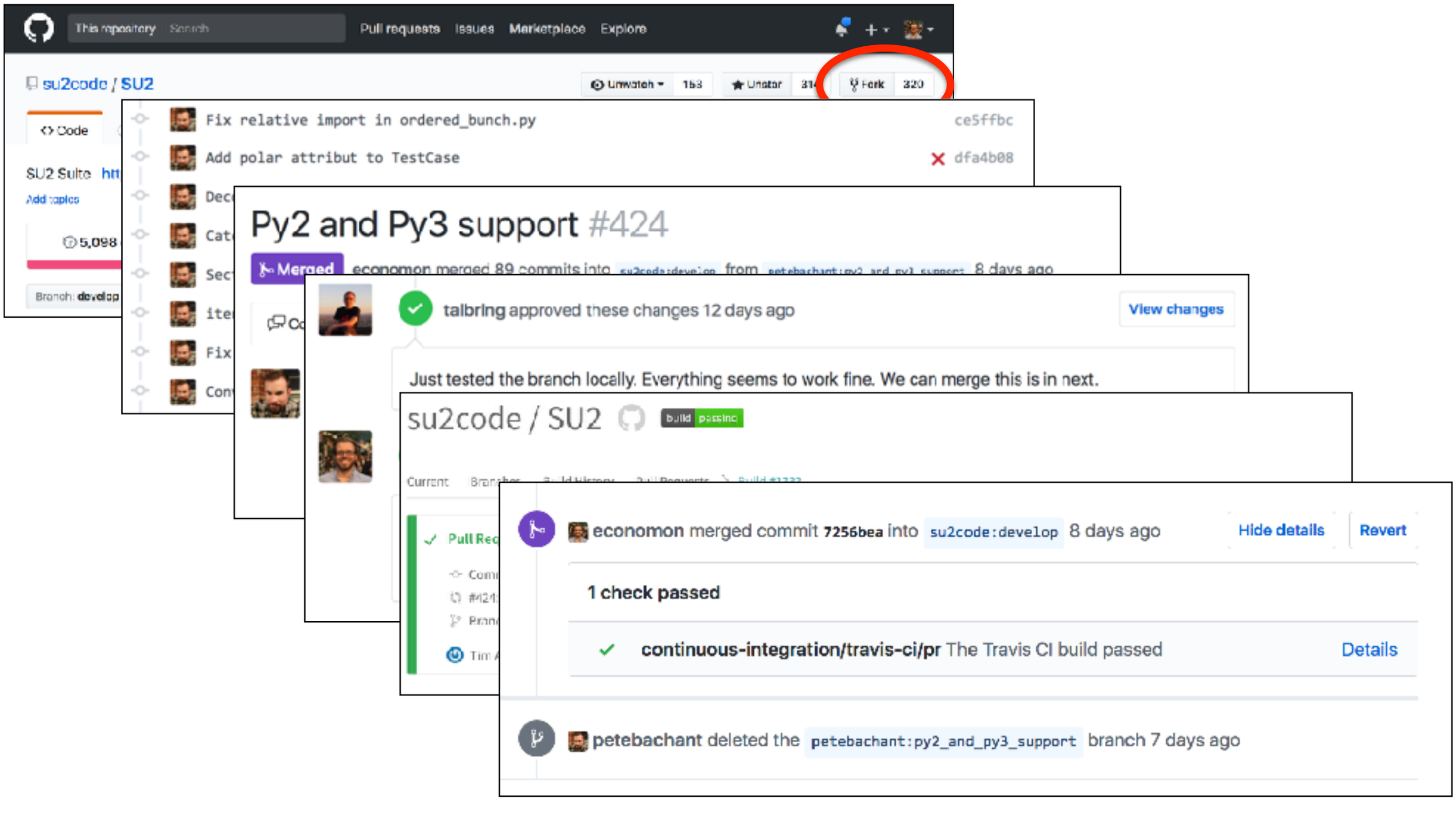
Lines of Code in SU2 by Release (w/out comments or blanks)



*includes code in externals/

Anyone can be an SU2 Developer.

Fork/Branch — Commit — Pull Request — Reviews — Regressions — Merge



74 Pull Requests in 2017

1,385 Commits Staged for Release

18,193 Code Lines Staged for Release

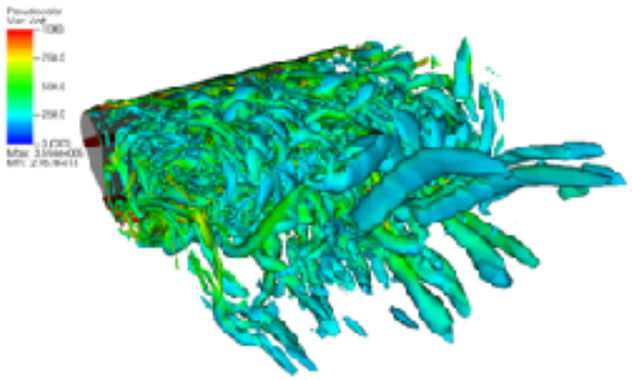
179 Continuous Regression Tests

109 Active Branches in Repository

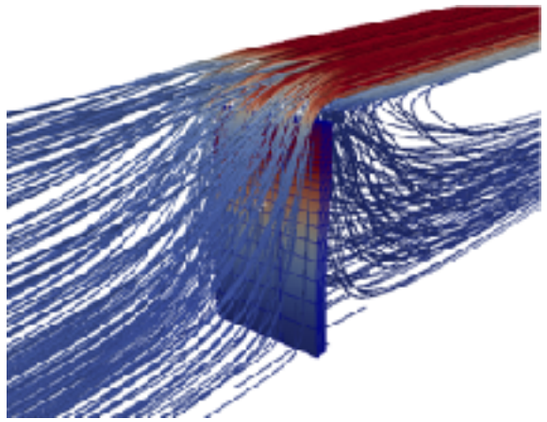
320 Active Forks on GitHub

As of 12.14.2017

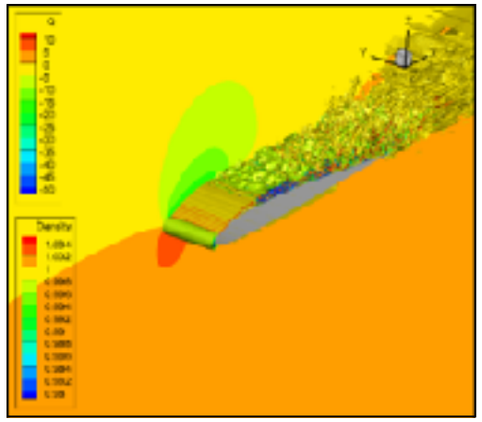
Some Topics for Today



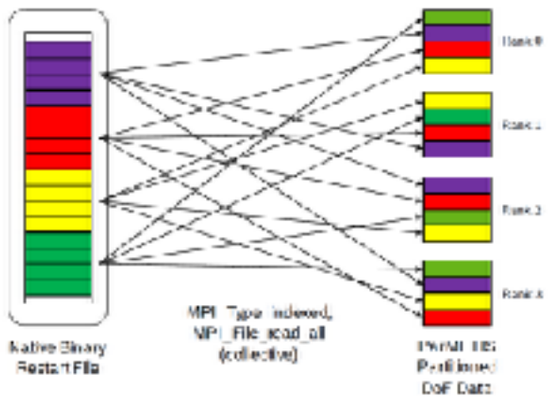
Delayed Detached Eddy Simulation (DDES)



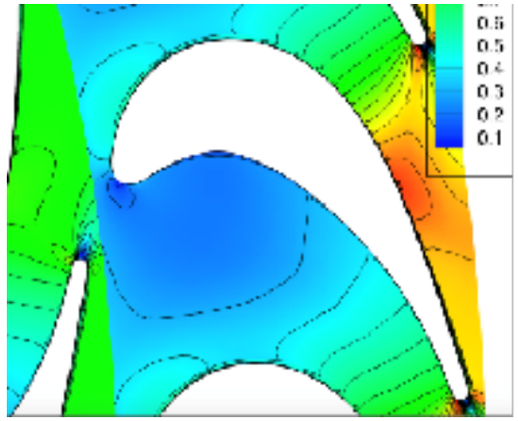
Coupled-Adjoints for FSI



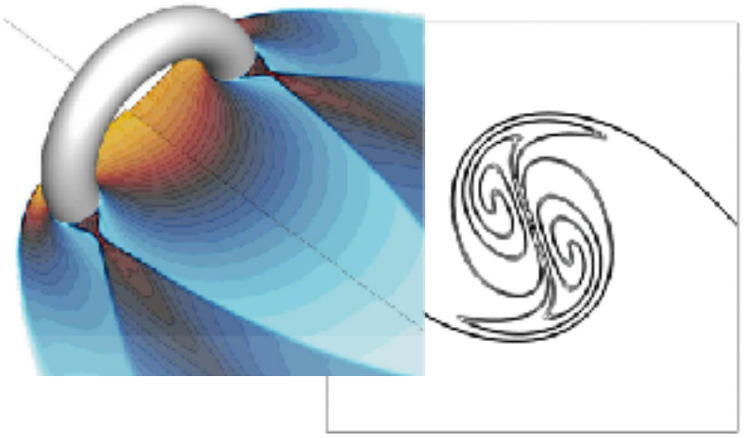
High-Order DG-FEM Solver for iLES/LES/DNS



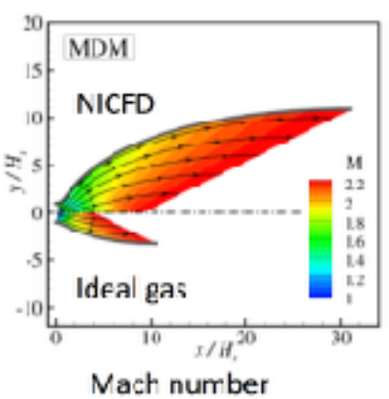
Parallel Performance Upgrades



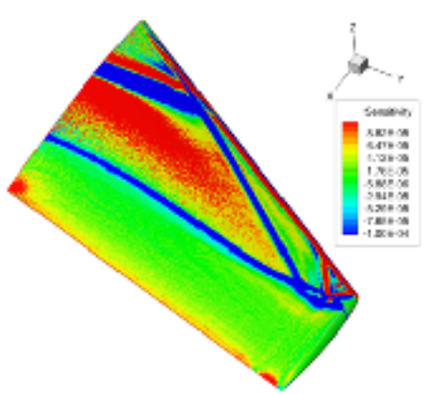
Adjoint-based Turbomachinery Design



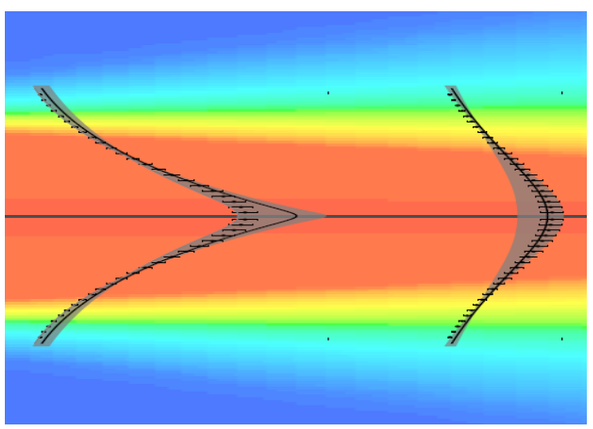
High-Speed Schemes. High-Order Schemes



Non-Ideal Compressible-Fluid Dynamics



Discrete Adjoint-Based Optimization



Uncertainty Quantification for RANS

Open source is everywhere. Join us.

“In the tech community, there is a lot of momentum behind open source and this notion that, if everyone shares information, we'll all grow more quickly and all know more eventually. So, there's no reason to keep secrets. We really live that theory, and it feels like it's working for us as well …"

“… if you put information out there, somebody else is going to pick up the book, think ‘Hey, this looks kind of interesting,' start making chocolate, discover something you don't know, and get in touch with you.”

Greg D’Alesandre.
Co-owner, vice-president of research and development, Dandelion Chocolate.
On tech roots playing a role in releasing a book on chocolate creation from scratch.
KQED Forum Radio Program Airing December 15, 2017.

2nd Annual SU2 Developers Meeting

December 18th, 2017

Stanford University, Durand Building, Room 450

Stanford, California, 94305, USA

SU2

The Open-Source CFD Code

Meeting Agenda

0800 – 0825: Welcome & Year in Review, *J. Alonso, Stanford, T. Economon, Bosch, F. Palacios, Boeing*

0825 – 0850: Upgrades for Parallel Performance and Low Speed Flows with Heat Transfer
T. Economon, Bosch

0850 – 0915: Implementation and Assessment of High-Order Methods in the Framework of SU2
K. Singh, D. Drikakis, I. Kokkinakis, M. Frank, University of Strathclyde
A BGK-Kinetic Formulation Including Vibrational and Electronic Energy Modes
A. Mogavero, J. Herrera-Montojo, M. Fossati, University of Strathclyde

0915 – 0940: Current Developments and Applications Related to the Discrete Adjoint Solver in SU2
T. Albring, N. Gauger, et al., TU Kaiserslautern

0940 – 1005: Coffee Break

1005 – 1030: An Overview of DDES in SU2: Implementation and Recent Results
E. Molina, R. G. A. da Silva, Aeronautical Institute of Technology (ITA-Brazil)

1030 – 1055: Recent Advances in Flow Analysis Capability and Adjoint-based Design for Turbomachinery with SU2
M. Pini, S. Vitale, A. Rubino, L. Azzini, N. Anand, P. Colonna, TU Delft

1055 – 1120: Uncertainty Estimation of Turbulence Model Predictions in SU2
J. Mukhopadhaya, A. Mishra, G. Iaccarino, J. Alonso, Stanford

1120 – 1145: Coffee Break

1145 – 1210: SU2: A Reliable Computational Framework for Non-Ideal Compressible-Fluid Dynamics Applications
G. Gori, Politecnico di Milano, P. M. Congedo, Inria - Bordeaux Sud-Ouest, A. Guardone, Politecnico di Milano

1210 – 1235: Coupled Adjoint-based Sensitivities Using the SU2 Native FSI Solver
R. Sánchez, C. Venkatesan-Crome, R. Palacios, Imperial College

1235 – 1300: Development of a Nodal DG Solver within the SU2 Framework
E. van der Weide, University of Twente, J. Choi, Stanford, D. Mudigere, Intel Labs, P. Urbanczyk, J. Alonso, Stanford

In order to participate (in-person or virtually), please register for the meeting by following the link on the SU2 home page (https://su2code.github.io).
Thanks for your interest and note that all stated times are Pacific Standard Time (PST).

Stanford · Technische Universität Kaiserslautern · TU Delft · Imperial College London · University of Twente. · Politecnico di Milano · ITA · Bosch

Institutions that have downloaded SU2. Sized by frequency.