



Chrono Tutorial

University of Wisconsin – Madison

January 9 – 13, 2017





Tutorial, Odds and Ends

- Tutorial run by
 - Dan Negrut, Faculty, University of Wisconsin-Madison
 - Radu Serban, Scientist, University of Wisconsin-Madison
 - Alessandro Tasora, Faculty, University of Parma, Italy
- Four days – starting Mo at 1 pm, wrapping up on Friday at noon
- Slides available online: <http://outreach.sbel.wisc.edu/ChronoTutorials/2017/UW/>
 - Made available at the beginning of each day
 - PPTX and PDF formats
 - No movies embedded in the PDF files



Acknowledgments

- Financial Support
 - US Army Rapid Innovation Fund grant W911NF-13-R-0011, Topic ``Maneuverability Prediction''
 - National Science Foundation
 - Army Research Office

- Collaborators
 - Professor Hiroyuki Sugiyama's group, University of Iowa
 - Finite Element Analysis

- Shelby, for taking care of logistics, accommodations, registrations,...



Course structure – Day 1

- Afternoon: 1:00pm – 5:00pm. Emphasis on “[getting started](http://www.projectchrono.org/)” aspects
 - Overview of Project Chrono (<http://www.projectchrono.org/>)
 - Summary of C++ features needed to work with Chrono
 - Fundamentals of Git and GitHub (for obtaining the code)
 - CMake: basic concepts (for compiling the code)
 - Hands on – Getting started with Chrono (configuration, build, running demos)

Course structure – Day 2

- Morning: 8:30am – noon. Emphasis on “rigid body dynamics”
 - Theoretical aspects related to the dynamics of systems of rigid bodies
 - MBS modeling support in Chrono
 - Visualization solutions in Chrono
 - Hands on – Dynamics simulation of a slider crank in Chrono
- Afternoon: 1:00pm – 5:00pm. Emphasis on “friction and contact”
 - Handling friction and contact in Chrono: modeling aspects
 - Collision detection in Chrono
 - Solution methods (time-steppers and solvers)
 - Hands on – Handling of friction and contact in Chrono: slider crank mechanism, revisited

Course structure – Day 3

- Morning: 8:30am – noon
 - General concepts of parallel computing relevant in Chrono
 - Chrono::Parallel and granular dynamics
 - Chrono – Python interoperability
 - Interface to SolidWorks
 - Support for modeling robotic systems
- Afternoon: 1:00pm – 5:00pm. Emphasis on “[finite element analysis](#)”
 - Elements of the theory of nonlinear FEA
 - Chrono::FEA tutorial
 - Hands on – Modeling with beam elements, contact with meshes, specifying loads

Code structure – Day 4

- Day 4 dedicated to [Chrono::Vehicle](#)
- Morning: 8:30am – noon
 - Chrono::Vehicle tutorial (code design and architecture, simulation framework, visualization)
 - Hands on
 - Chrono::Vehicle demos and test programs
 - Extracting output; off-line visualization
- Afternoon: 1:00pm – 5:00pm
 - Chrono::Vehicle tutorial – wheeled vehicles
 - Chrono::Vehicle tutorial – tracked vehicles
 - Hands on
 - Specifying a vehicle model through JSON files
 - Creating/modifying JSON specification files



Code structure – Day 5

- Morning: 8:30am – noon
 - Chrono::Vehicle co-simulation support using MPI
 - Interfacing to MATLAB/Simulink
 - Advanced features in Chrono
 - Support for computational fluid dynamics (SPH)
 - Support for Fluid-Solid Interaction
 - Chrono, looking ahead
 - Autonomous vehicle support
 - Support for sensors
 - Feedback, course evaluation, wrap up

Before we dive in...



- Long week ahead...
- Please ask questions to keep this from getting super boring
- Stay engaged to make your time here worthwhile



Logistics

- Lunch served on Tu, Wd, Th, and Fr
- Snacks throughout day
- Dinner together on Tuesday night
 - Probably heading out to Brasserie V for a good burger/beer combo
- Kind request: do not bring food into lecture room
 - The instructors might get deported



Welcome to UW-Madison!

Very happy to have you here.