Verification in Visualization: Building a Common Culture

IEEE VisWeek Panel

Organized by Robert M. Kirby (Utah) and Claudio T. Silva (NYU-Poly)

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The Panelists

- Robert M. (Mike) Kirby - University of Utah
  - ➡ “V&V in V”: What does validation and verification in visualization look like?
- Claudio Silva - NYU-Poly
  - ➡ The Role of the “User” in the V&V of Visualization
- Robert (Bob) Laramee - University of Swansea (UK)
  - ➡ Verification of Visualizations: A Software Engineering Perspective
- Will Schroeder - Kitware
  - ➡ Once Verified, Always Verified?

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Nomenclature

Definitions taken from American Institute for Aeronautics and Astronautics (AIAA) document AIAA G-077-1998: “Guide for the Verification and Validation of Computational Fluid Dynamics Simulations”

- **Validation**: The process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model.

- **Verification**: The process of determining that a model implementation accurately represents the developer's conceptual description of the model and the solution to the model.

History of V&V Within CS

- (ACM) Validation, Verification, and Testing of Computer Software by W.R. Adrion, M. A. Branstad, and J.C. Cherniavsky

Validation: Determination of the correctness of the final program or software produced from a development project with respect to the user needs and requirements. Validation is usually accomplished by verifying each stage of the software development life cycle.

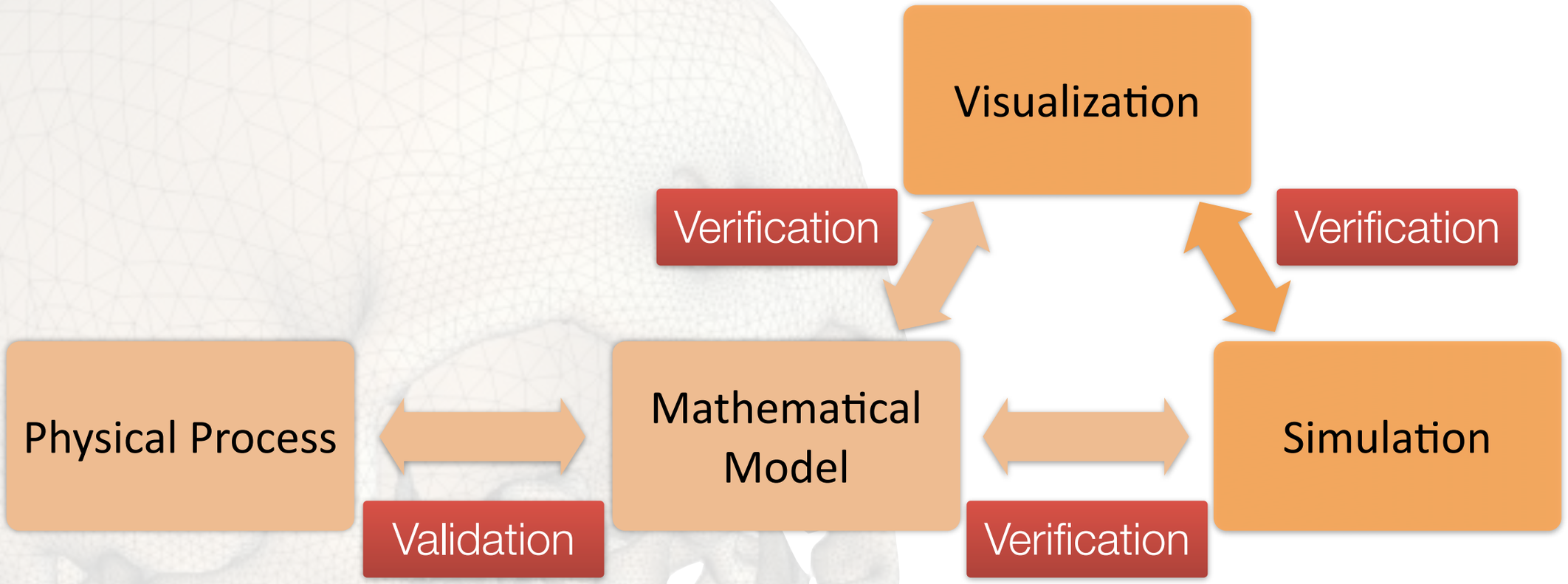
Verification: In general, the demonstration of consistency, completeness, and correctness of the software at each stage and between each stage of the development life cycle.

Traditional Scientific Simulation Pipeline

Validation – Does the mathematical model represent the physical phenomena correctly?

Verification – Does the computational model and its implementation represent the mathematical model accurately?

Revised Scientific Simulation Pipeline (Kirby and Silva)



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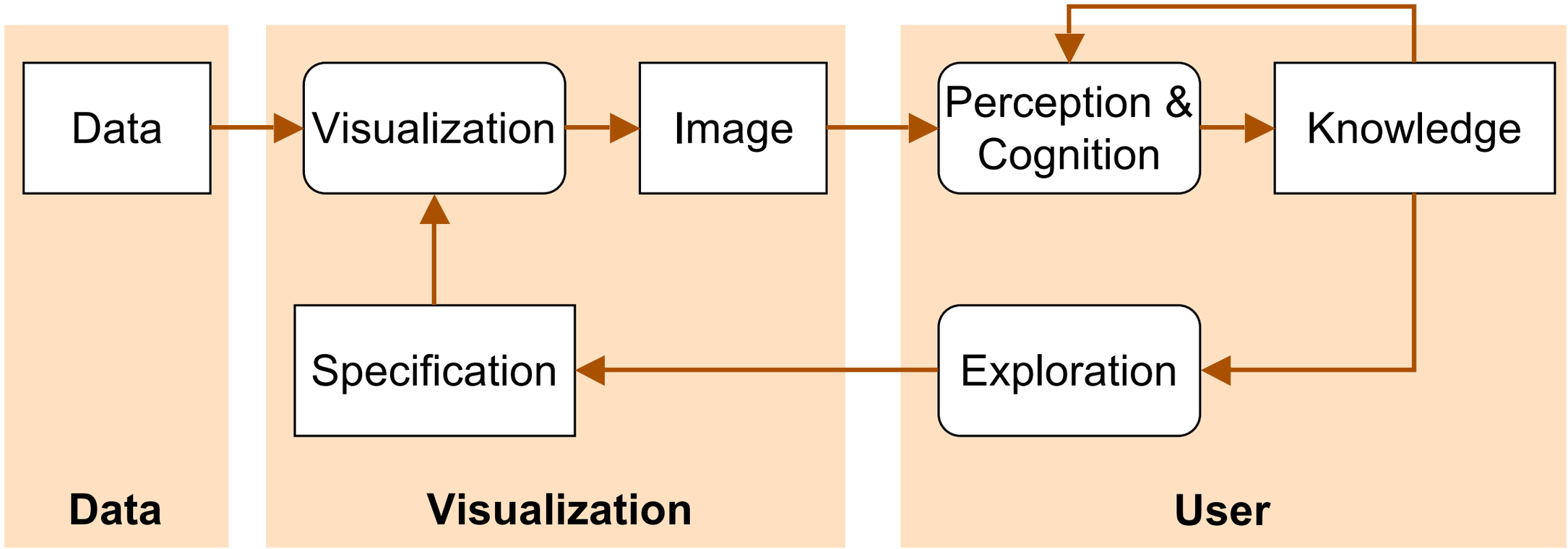
What Communities Now Explicitly Mention V&V?

- US Department of Defense
- US Department of Energy
- US Department of Education
- American Institutes of Aeronautics and Astronautics (AIAA)
- IEEE
- American Society of Mechanical Engineering (ASME)
- National Institute of Standards (NIST)
- Various Engineering Companies (tgstech, datamatics, etc)

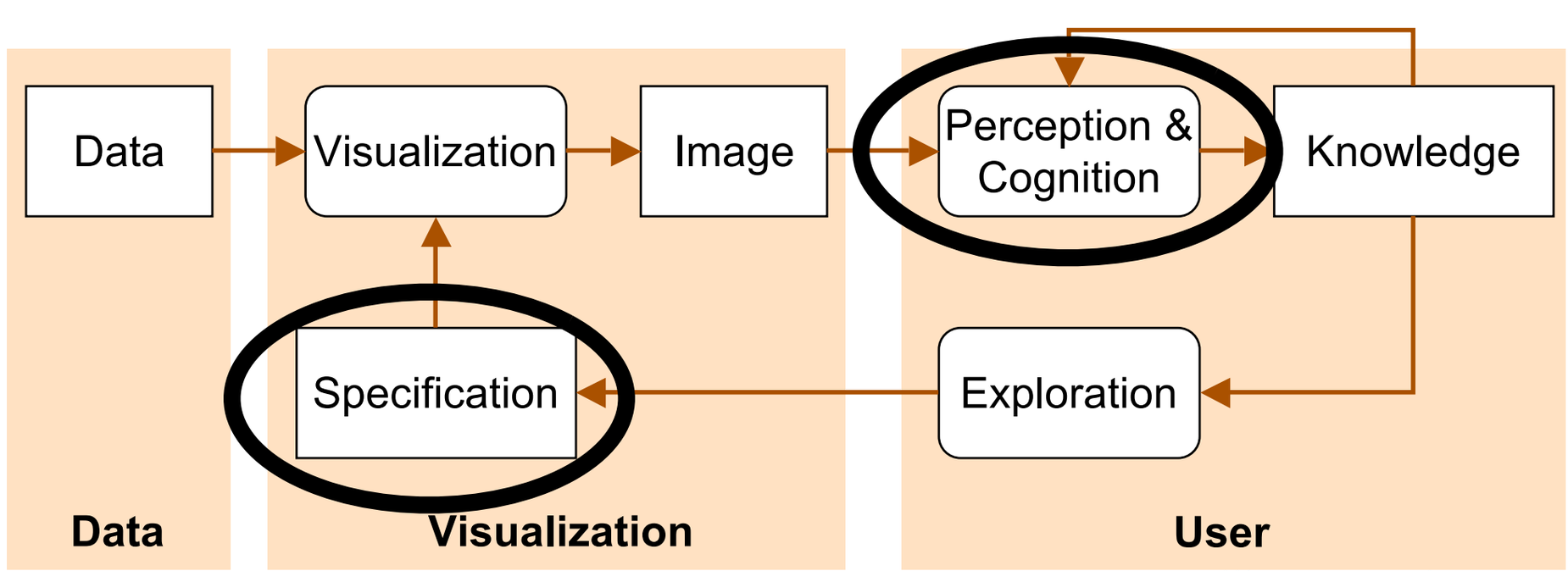
Data Exploration through Visualization



J. van Wijk, IEEE Vis 2005

Verification in Visualization

- Is it possible to know if we are displaying the “right” information to the users? That is, is the implementation of our algorithms “correct”?
- Is it possible to “measure” how well the information that we are displaying is being interpreted by the user?



J. van Wijk, IEEE Vis 2005

What Would A Culture of Verification Look Like?

- Workshops for Comparison: Example: AIAA Drag Workshop and Aeroacoustics Workshop (in which “codes” go head-to-head to see how they compare when applied to realistic problems)

- Common (Community) Datasets Upon Which All Visualization Methods are Tested

- Consistent Expectations Concerning What Verification Steps are Provided in Papers (Most AIAA, ASME, etc., papers require an explicit section within a published paper devoted to Verification)

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What Would A Culture of Verification Look Like?

- How do we express and measure efficacy?

- What about visualization methodologies for which there are not necessarily underlying mathematical principles driving their derivation -- information visualization?

- Were does perception, cognitive science, and decision-making come into the process?