40. "SIMULATION-SUPPORTED LEARNING"

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SUMMARY

Simulation can help people learn. People learn from doing. Expertise is gained by doing something often (10,000 hours has been identified as the point after which someone gains enough proficiency to be considered an expert). Some kinds of experience can be difficult to obtain, and be costly, and/or dangerous as well. Simulation is used as a tool to augment experience; an example is aircraft simulators used in pilot training. Computer simulation can be further used to learn design engineering. However, it is often hard to know if a simulation captures reality, or is a cartoon. Independent validation is needed to ensure simulation actually captures reality. It is the ability of the simulation process to scale across the user community that enables independent verification. This can most readily be accomplished today by incorporating variability in physics-based analyses using Monte Carlo methods. Replacing discrete values in an analysis with a range and distribution and conducting multiple analyses to conduct a simulation is a simple process that most people can master. This simple process enables users to focus on the problem they are addressing, as opposed to the methodology being used to address a problem. Monte Carlo methods also scale with problem size and problem type, independent of the numbers of variables. The ability to incorporate more variables reduces the need for assumptions. Fewer assumptions increase the prospect of learning (finding out something from the simulation we did not previously know). Commodity computing prices address past concerns with Monte Carlo methods being too compute intensive. The clouds of results generated through Monte Carlo methods provide credible simulation, which can be used to learn. Monte Carlo simulation identifies which variables and combinations of variables have the most influence on functionality, as well as outliers that generate unexpected results. This information provides the foundation for learning in engineering design.