

The development & Future of Multibody Dynamics in the aspects of industry requirements

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In the presentation, the decades of historical researches & developments of rigid and flexible multibody dynamics is introduced in terms of academic research, commercial MBD program development, and industry requirements, respectively.

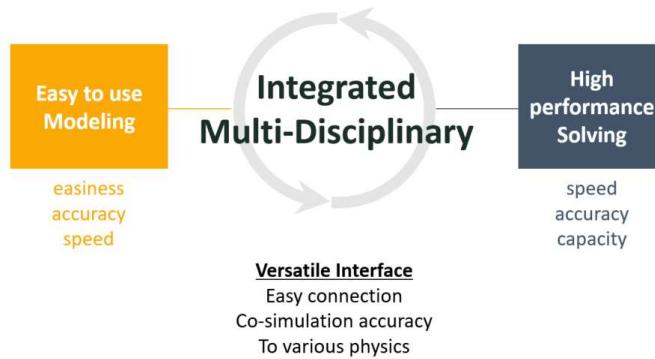


Fig. 1: Industry demanding for mechanical CAE

As other Mechanical CAE as shown in Fig 1, multibody dynamics has been researched and developed quite rapidly from the kinematic problems to rigid & flexible multibody dynamics in the environment of multi-physics phenomenon. From late 1990, according to the dramatic development of computer H/Ws and S/Ws, MBD is also passing through the period of motion based multi-discipline problems, such as interactions of linear & nonlinear structure analysis, control & mechatronics, fluid & thermal, optimization, and many other applications. The popular computational formulations and computer technics for multi-physics based MBD is explained clearly in the level of industry demanding and specifications. The Tab 1 represent the possible combination of MBD formulations, coordinates, and numericals used in the commercial program.

	A	B	C	D
Formulation	Complete Recursive Recursive without elimination	Augmented	Augmented	Projection Methods Recursive with elimination
Coordinate System	Relative	Absolute	Absolute	Absolute/Relative
Governing Equation	ODE/Minimum DAE-Close loop	DAE	DAE	ODE/Minimum DAE-Close loop
Calculation	Strict order n (1.0)	Order 1.5-3	Order 1.5-3	Order n (1.0)
Numerical Method	Numeric	Numeric	Numeric	Symbolic/Numeric
Integration Method	Implicit	Implicit	Explicit type Implicit	Explicit type Implicit

Tab. 2: Possible combination of MBD formulation

Afterward the role of MBD simulations in virtual development process is shown with several practical applications, and those implementations into commercial code is represented briefly. Finally, the future challenges and the possible directions of MBD tool for next decades are suggested, which are actively moving in the community. Fig 2 shows one of the examples of the future or concurrent activities in industry.

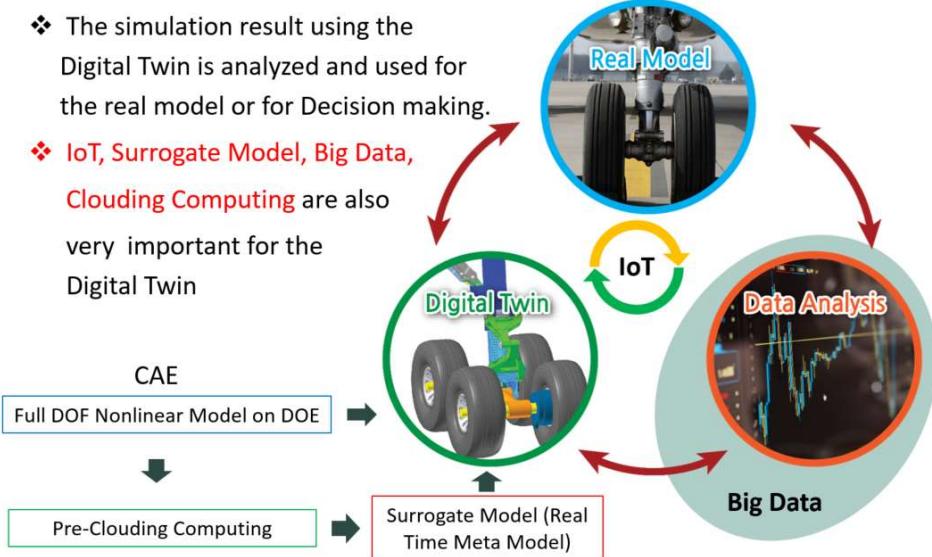


Fig. 2: Data Driven Design and Digital Twin

References

- [1] A. Shabana, *Dynamics of Multibody System*. Cambridge University Press, 3 ed., 2005.
- [2] FunctionBay Inc., “RecurDyn Manual,” 2018.
- [3] Jin. H. Choi, “MBD after multi-physics,” in keynote speech of *International CAE conference*, Vicenza, Italy, 2017.