Dynamic Phenomenon Analysis Technology

(1) Aims

The main subjects of the mechanical engineering and measurement control field include solution of dynamic phenomena, establishment of analysis methods and improvement of technologies. The degree of freedom is one of the parameters expressing complexity of the applicable dynamic system configuration. In general, increasing the degree of freedom creates more accurate models of dynamic phenomenon and produces more reliable mechanical products.

The problem of dynamics is related to many points of view, such as linearity and non-linearity, forward and reverse problems (design problems), theoretical and numerical analyses, and modeling problems. We considered and arranged them in order here from the viewpoints of the degree of freedom handled by the dynamic phenomenon analysis technology. We also prepared a roadmap for developing mechanical products with advanced functions meeting complicated needs so that engineers may bear the social responsibility, save resources, maintain the environments, and ensure users' safety.

(2) Social and technical needs

The following shows the social and technical needs that the dynamic phenomenon analysis technology meets:

- Products that provide the users with not only the structural safety but also comfort
- Development of safe, high-efficiency and high-speed machines effective for energy saving
- Development of mechanical products that may be used by elderly people safely.

(3) Future directions for determining key mechanisms and parameters

The following shows the possibilities of increasing the degree of freedom expressed as the vertical axis of the graph and enabling advanced and large-scale dynamic phenomenon analyses:

- Breakthrough of the fundamental theories related to vibrations, impacts, non-linear phenomena, etc.
- Establishment of the methodology that links the progress of the fundamental theories with development of actual products
- Education of developers with advanced analysis capabilities who share the above-mentioned fundaments and practical execution
- Establishment of advanced analysis models and solution methods of complicated structures
- Large-scale dynamic FEM analyses will depend on development of higher-speed and larger-capacity computers.

(4) Contributions to society

- It is essential to develop the technologies for coping with exhaustion of oil and other natural energy resources. All industrial products must be light in weight with advanced functions. Accordingly, dynamic phenomena must be clarified. If these problems are solved, the sustainable resource saving society will be achieved.
- If development of the dynamic phenomenon analysis method may be linked with systematization, including the design skills, safety management and control technology, from the comprehensive point of view, human-friendly technologies linked with users' safety and sensitive satisfaction will be enabled.

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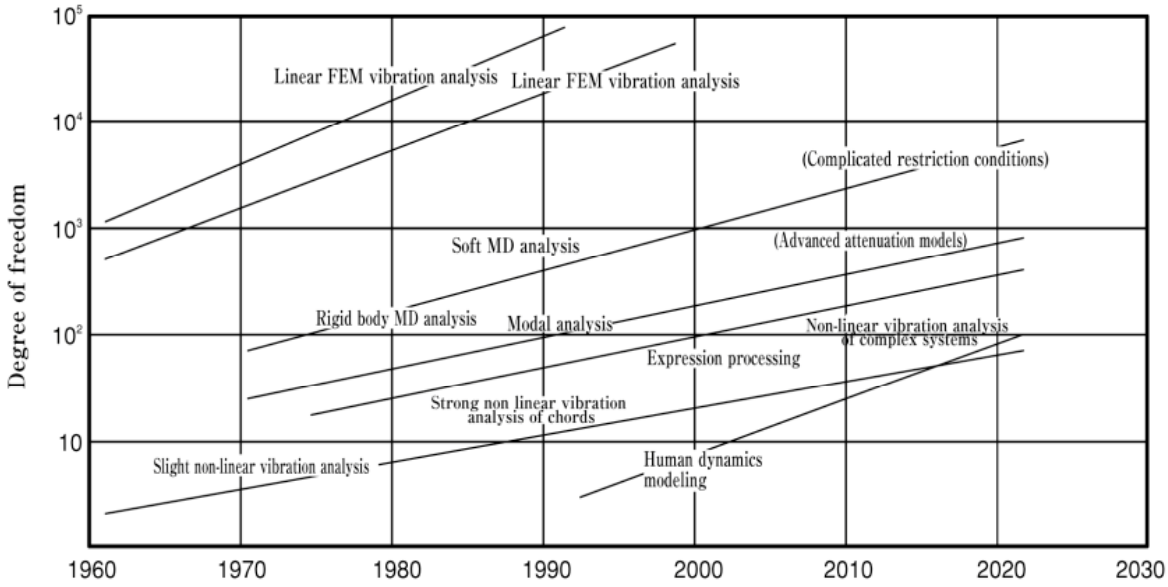
Social & Technical Needs

1960～1970	・Expectation for improvement of lives pursuant to economical growth
1970～1980	
1980～1990	・Noise reduction of cars
1990～2000	・Expectation for utilization of space environment
2000～2010	・Technology for relief and safety ・Development of high-efficiency airplanes
2010～2020	・Machine weight reduction technology for environment preservation ・Tendency to society with many elderly people
2020～2030	



Technical Breakthrough

1960～1970	・Shinkansen line was put into practical use.
1970～1980	・Expansion of FEM technologies
1980～1990	・Progress of dynamic phenomenon measurement technologies
1990～2000	・Expansion of PCs ・Expansion of Internet technologies
2000～2010	・Continuous progress of high-speed and large-capacity computers
2010～2020	・Progress of unified theory that can handle non-linear dynamic phenomena in unified manner
2020～2030	

Changes in Society and Markets

1960～1970	
1970～1980	・First oil shock
1980～1990	・Second oil shock
1990～2000	・Low economic growth after collapse of bubble economy ・Expansion of Internet
2000～2010	・Markets' expectation for nano-technologies ・Growth of Chinese market
2010～2020	・Development of products meeting individual senses and market with many elderly people
2020～2030	

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