**IADS标准新工作提案表**

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| **提案名称** | 人体有限元模型验证方法及技术要求 |
| **涉及专利情况** | 无 | **计划项目周期（月）** | 12月 |
| **牵头单位** | 中国汽车工程研究院股份有限公司 | **项目所属TC** | 行驶安全 |
| **负责人姓名** | 刘煜 | **所在单位** | 中国汽车工程研究院股份有限公司 |
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| **范围** | *（请简述标准的范围，明确本标准所涉及的技术边界）*本文件规定了人体有限元模型的验证方法及技术要求，从节段模型到整人模型两层面依次对组成成分、验证工况、边界条件、结果分析等做出规定和要求。本文件适用于所有成年体征人体有限元模型的验证。以中国50百分位男性体征具体说明，其他体征可参考执行。 |
| **立项目的** | *（请从标准拟解决的市场需求、前瞻问题、客户受众价值等方面以及后续的应用路径，描述本标准拟立项目的）***1.拟解决的市场需求：**国内外汽车安全测评机构均准备引入人体模型进行虚拟测评，不同体征人体模型响应存在差异，对测评结果具有重要影响，建立统一的人体有限元模型验证标准有益于提升人体模型生物逼真度和适用性，满足汽车行业采用人体模型进行损伤评估的需求。此外，军工领域、医学领域、航天航空领域同样需要可靠有效的人体有限元模型及相应验证标准。**2.前瞻问题：**相较于假人模型，人体有限元模型具备详细解剖学结构，能更准确地反映人体动力学和损伤响应，但受限于计算效率和求解原理，仍有提升空间，需基于当前人体模型水平制定合理的验证标准。并且随着平等性、个性化需求增加，标准需考虑如何适应多样化需求。**3.客户受众价值：**对于汽车行业、军工行业、航天航空行业，标准化人体有限元模型验证方法和技术要求，可提高人体模型的准确性和一致性，更准确的评估汽车及其他机械结构的碰撞安全性，提高产品安全性设计性能，降低研发成本。在医疗行业可以提高医疗设备的安全性，降低医疗风险。在科研机构及高校，可促进学者对损伤机理和评价标准的深入研究，推动人体工学、生物力学等学科发展。**4.后续应用路径：**先明确人体模型验证方法和技术要求，从而促进相关单位开发符合标准的人体模型，以应用于测试机构的汽车安全虚拟测评当中，助力汽车制造商优化安全设计，随后扩展到医疗仿真、军工设计、航天航空安全等领域。 |
| **立项必要性** | *（请从市场需求、技术需求、标准需求等方面分析标准立项的必要性）***1.市场需求：**在汽车安全、军工、航天航空、体育用品等领域，均需要高精度高生物逼真度人体模型，以模拟分析受到冲击时人体的损伤情况和防护装备对人体的保护效果，而医疗领域也需要高精度人体模型来进行手术模拟和康复治疗方案制定等。因此需要制定统一的人体模型验证方法和技术标准来确保模型的准确性和可靠性，为后续研究提供可靠依据。**2.技术需求：**当前不同研究机构和企业开发的人体有限元模型在精度和可靠性方向存在较大差异，制定统一的验证方法和技术要求可以规范化模型的构建和验证过程，提高模型的整体质量和可信度。而且统一的验证标准可以为国内外研究机构提供一个共同的技术平台，便于不同机构的技术交流和模型评估，促进技术共享和创新，提高行业整体技术水平。**3.标准需求：**目前人体模型繁多，性能不一，构建相应验证标准可以规范市场秩序，提供客观公正的评价依据，促进供应商提高产品质量，有助于推动人体模型应用到汽车、医疗、军工、航天航空等多个领域，实现各个领域的协同发展和跨界合作，推动产业健康发展。 |
| **标准分析** | *（简要分析国内外相关技术标准现状，特别是ISO/IEC/ITU以及其他国际团体标准，说明本项标准与主要国际性标准的区别，主要区别应逐条列出）*EuroNCAP公布的《CP540-Pedestrian Human Model Certification》团体标准仅针对欧美体征的行人模型，并且仅从整人模型的运动轨迹层面对模型进行了验证要求。本标准提出的人体模型验证标准，会从各个节段以及整体模型两个层面对模型进行验证方法的制定，并且本标准技术要求较为严格，包括对运动学和力学等多种指标的规定。并且本标准不局限于某种体征或某种姿态的人体模型，具有较为广泛的适用范围。 |

**注**：

（1）项目所属TC请填写：“行驶安全/本质安全/控制安全/交互安全/健康安全”中其一

**IADS NEW STANDARD PROPOSAL**

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| **Proposal title** | **The Validation Methods and Technical Requirements for Human Finite Element Model** |
| **Patent involvement** | None | **Proposed Project Duration (month)** | 12 months |
| **Entity name** | CAERI | **TC** | Driving Safety |
| **Name** | Xiaofan Wu | **Affiliation** | CAERI |
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| **Scope to which the standard applies** | *[briefly describe the scope of the standard and clarify the technical boundaries involved in this standard]*This document specifies the verification methods and technical requirements for human finite element model, regulating components, validation conditions, boundary conditions, and result analysis for both segmental and whole body models.It applies to the verification of all adult human finite element models. Using the Chinese 50th percentile male as a specific example, and other physical characteristics can refer to this document for implementation. |
| **Purpose of the standard** | *[Please describe the purpose of this standard from the aspects of market demand, prospective problems to be solved, customer value and subsequent application path by the standard]***1. Market Demand :**Domestic and foreign automotive safety evaluation institutions are preparing to introduce human body models into virtual testing. The responses of human body models vary with the different physical characteristics, which significantly impact evaluation results. Establishing a unified standard for validating human finite element models is beneficial for enhancing the biofidelity and applicability of human body models, meeting the automotive industry's need for using human body models for injury assessment. Additionally, the military, medical, and aerospace sectors also require reliable and effective human finite element models and corresponding validation standards.**2. Prospective problems to be solved:**Compared to dummy models, human finite element models have detailed anatomical structures and can more accurately reflect human kinetics and injury responses. However, there is still room for improvement due to computational efficiency and solution principles. It is necessary to establish reasonable validation standards based on the current level of human body models. With the increasing demands for equality and personalization, the standard needs to consider how to adapt to diverse requirements.**3. Customer Value:**For the automotive, military, and aerospace industries, standardizing human finite element model validation methods and technical requirements can improve the accuracy and consistency of human models, more accurately assess the collision safety of automobiles and other mechanical structures, enhance product safety design performance, and reduce R&D costs. In the medical industry, it can improve the safety of medical devices and reduce medical risks. In research institutions and universities, it can promote in-depth research by scholars on injury mechanisms and evaluation standards, advancing the development of disciplines such as ergonomics and biomechanics.**4. Subsequent Application Paths:** First, clarify the verification methods and technical requirements for human body models. This will promote the development of standard-compliant human body models for use in automotive safety virtual testing, helping OEMs enhance safety designs. Subsequently, expand into other fields such as medical simulation, defense design, and aerospace safety. |
| **Requirements of the standard** | *[Please analyze the necessity of the proposed standard from the aspects of market demand, technical demand and standard demand]***1. Market Demand:**High-precision and high-biofidelity human body models are in strong demand across various fields, including automotive safety, military defense, aerospace, and sports equipment. These models are essential for simulating and analyzing human injuries under impact and evaluating the protective performance of safety equipment. In the medical field, accurate human body models are also needed for surgical simulation and rehabilitation planning. Therefore, it is necessary to establish standardized validation methods and technical requirements for human body models to ensure their accuracy and reliability, thereby providing a solid foundation for subsequent research and applications.**2. Technical Demand:**Currently, there are significant differences in the accuracy and reliability of human finite element models developed by different research institutions and companies. Developing unified validation methods and technical requirements can help standardize the model development and verification processes, thereby improving the overall quality and credibility of these models. Moreover, standardized validation requirements can provide a common technical platform for domestic and international research organizations, facilitating technical exchange, model evaluation, and promoting knowledge sharing and innovation, which in turn enhances the overall technical level of the industry.**3. Standard Demand:**Given the wide variety of human models with varying performance levels, establishing corresponding validation standards can help regulate the market, provide objective and impartial evaluation benchmarks, and encourage suppliers to improve product quality. Such standards will support the broader application of human models in fields like automotive, healthcare, defense, and aerospace, fostering interdisciplinary collaboration and driving the healthy development of the industry. |
| **Analysis of related technical fields at domestic and abroad** | *[Briefly analyze the relevant standards domestic and abroad, especially ISO/IEC/ITU and other international association standards, and explain the differences between these standards. The main differences should be listed]*Euro NCAP's group standard, "CP540-Pedestrian Human Model Certification," focuses only on pedestrian models of European and American physical characteristics, and it only validates models based on the motion trajectory of the whole body model. In contrast, the verification standard proposed in this document will develop validation methods for models at both the segment and whole-body levels. Moreover, this document's technical requirements are more stringent, covering multiple indicators such as kinematics and kinetic. This document is not restricted to human body models of specific physical characteristics or postures, thus it has a broader scope of application. |

**NOTE:**

1. Please fill in **TC** blanket using one of the following Names of Technical Committee: **Driving Safety**, **Intrinsic Safety**, **Control Safety**, **Interactive Safety or Wellness Safety**