Boston Dynamics Spot Robot Report

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Stream : Engineering

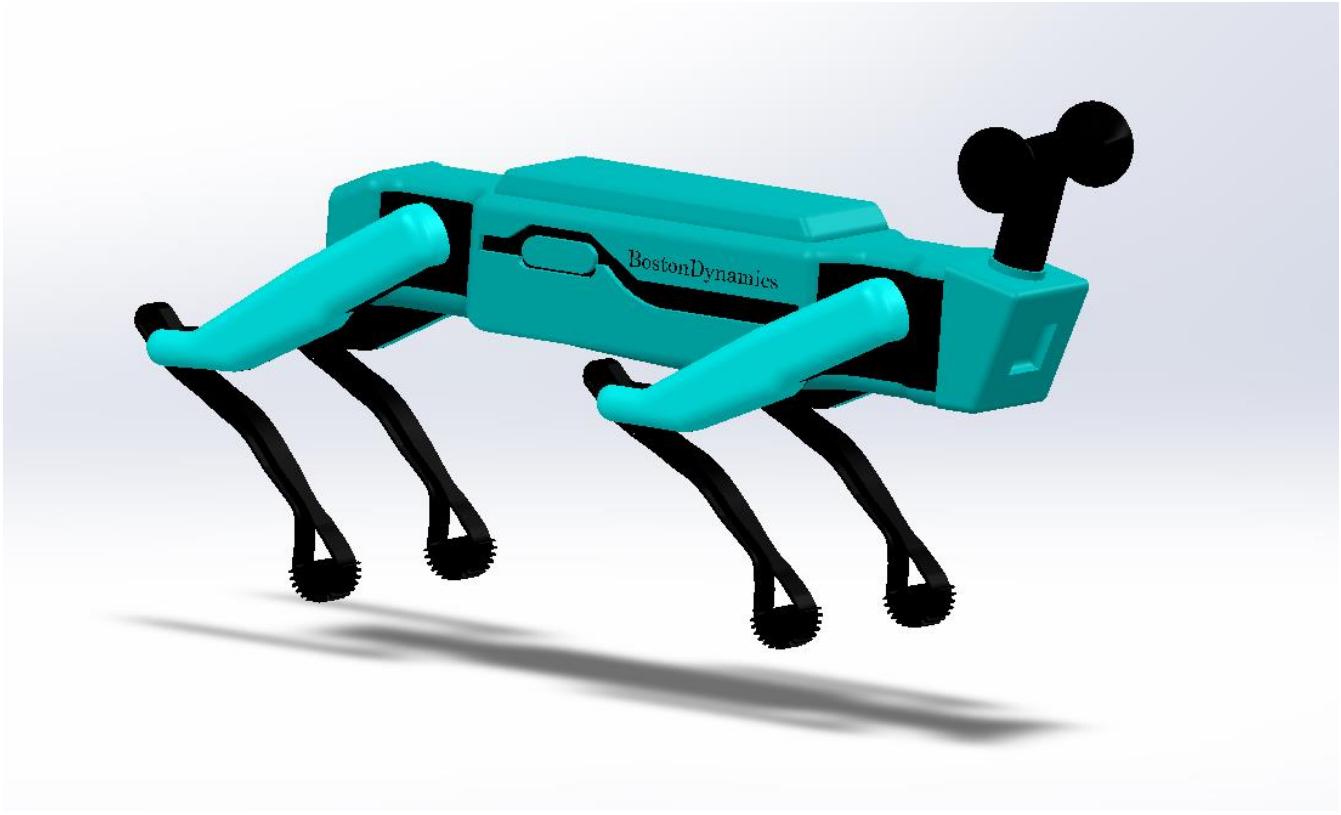
Class : Robotics and Automation

Class : 3rd Year

➢ Objectives of the Problem :

1. Able to climb up the stairs
2. Can carry some objects with it

➢ The primary aim of the project is to design a versatile robot capable of carrying objects with a payload capacity of up to 10 kg. This robot will be equipped with the ability to efficiently climb stairs. the goal is to ensure that the robot can navigate challenging terrains while carrying heavy loads, thus enhancing productivity and efficiency in industrial settings.

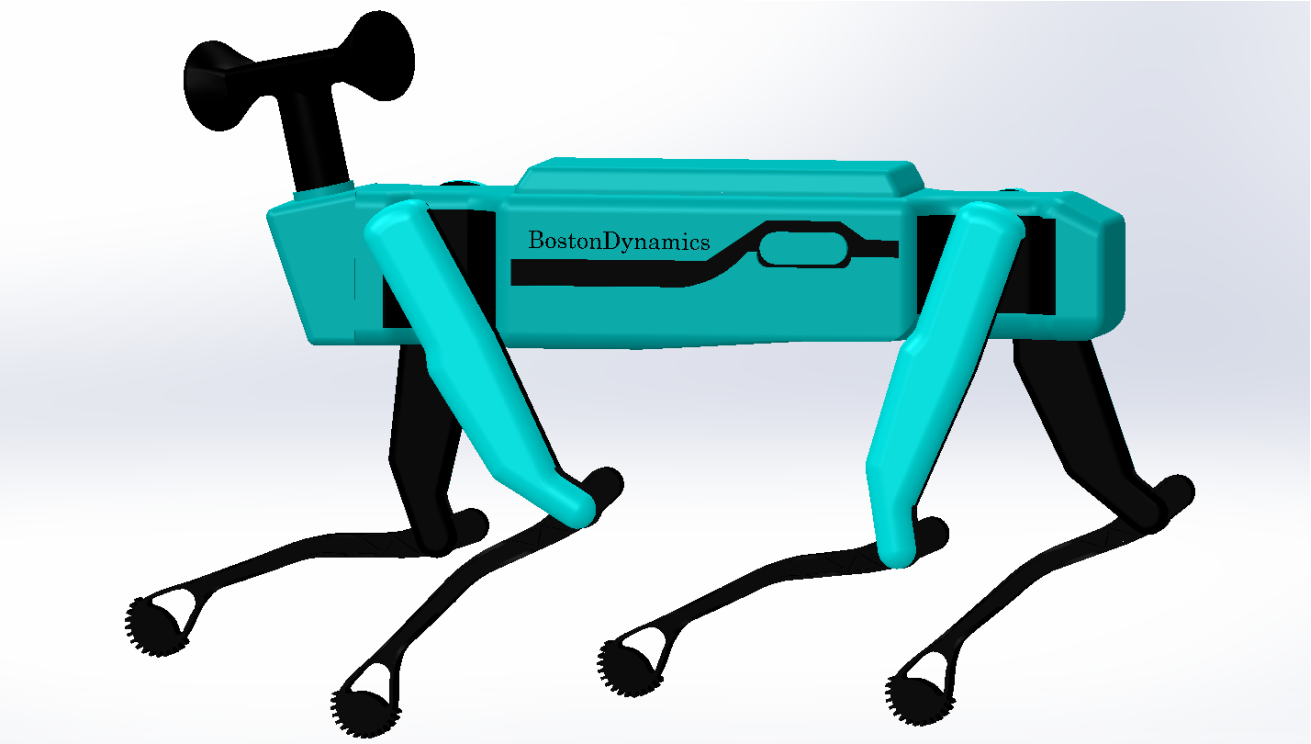


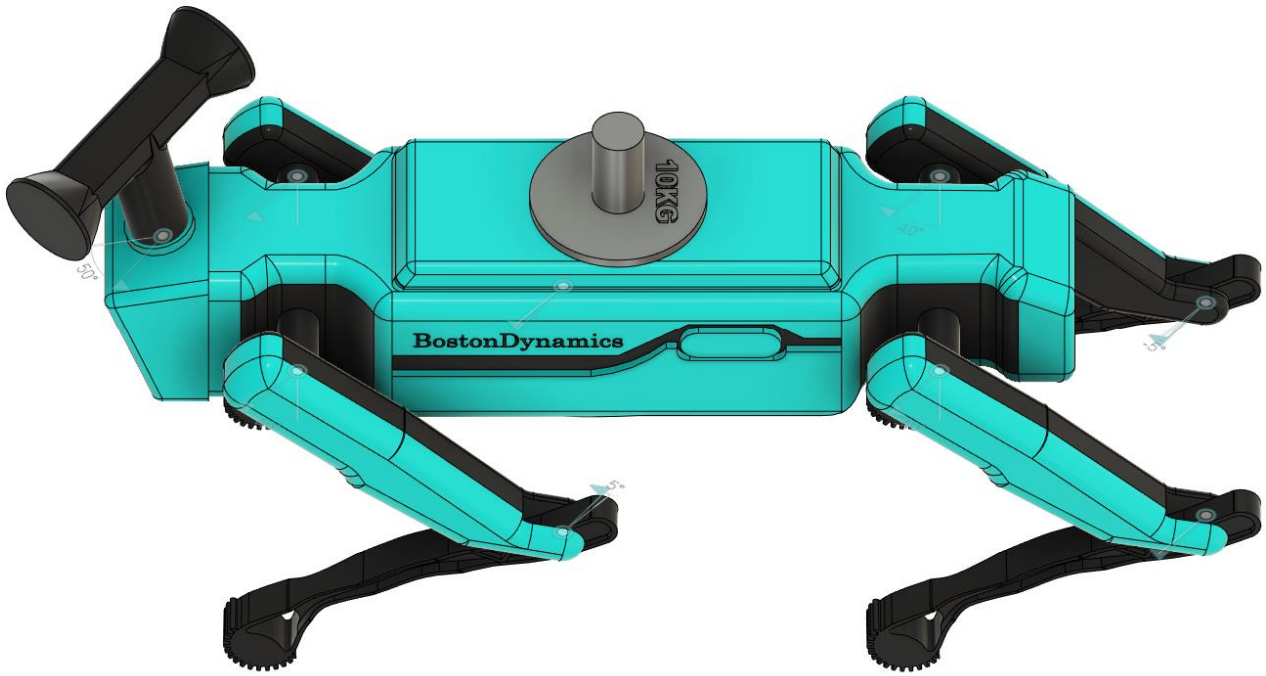
➢ Reference :

The design of the Boston Spot Robot draws inspiration from the pioneering work of Boston Dynamics and their Spot robot. By leveraging the design principles and capabilities demonstrated by the Boston Dynamics Spot, this project aims to emulate and enhance upon its functionality while incorporating unique features tailored to specific applications. The Boston Dynamics Spot serves as a reference point for the design process, guiding decisions on structural design, locomotion mechanisms, and sensory integration. By building upon the foundation established by Boston Dynamics, the Boston Spot Robot endeavors to push the boundaries of robotic innovation and address real-world challenges with increased agility and adaptability.

➢ CAD Model :

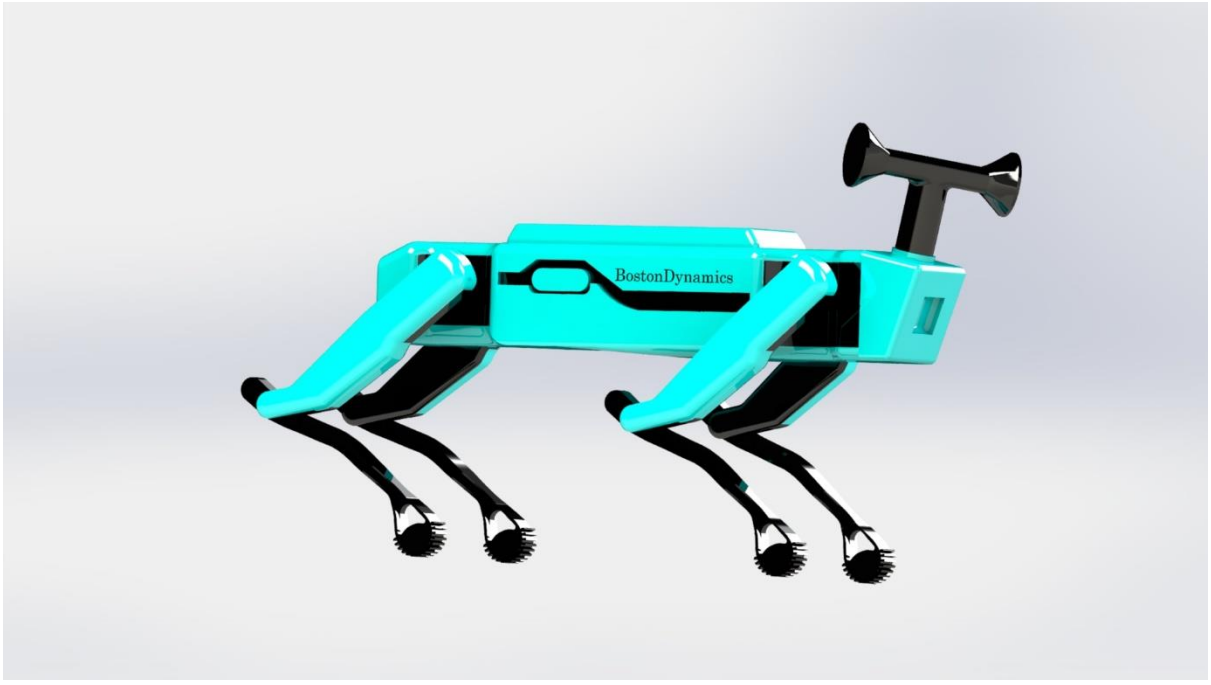
The CAD model is done in Solidworks Software





➢ Realistic Image :

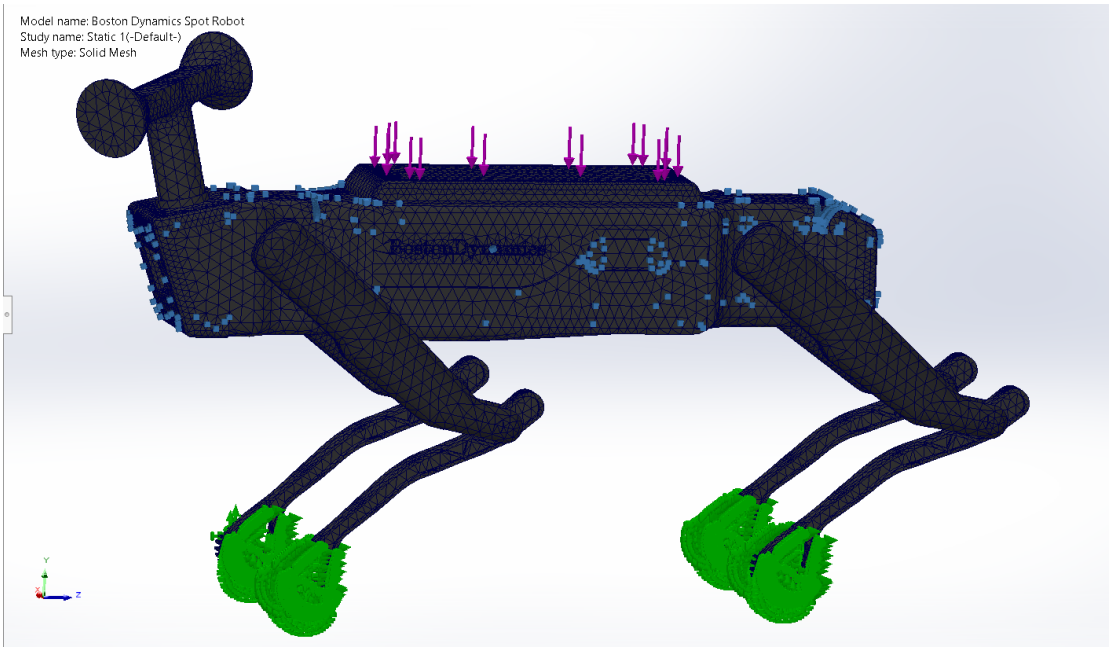
Incorporating advanced rendering capabilities within SolidWorks' Photoview 360, high-resolution images of the CAD model were generated to provide a realistic portrayal of the Boston Spot Robot. This rendering process not only showcases the intricate details and design features of the robot but also serves as a valuable visual aid for design evaluation and presentation purposes in the report.

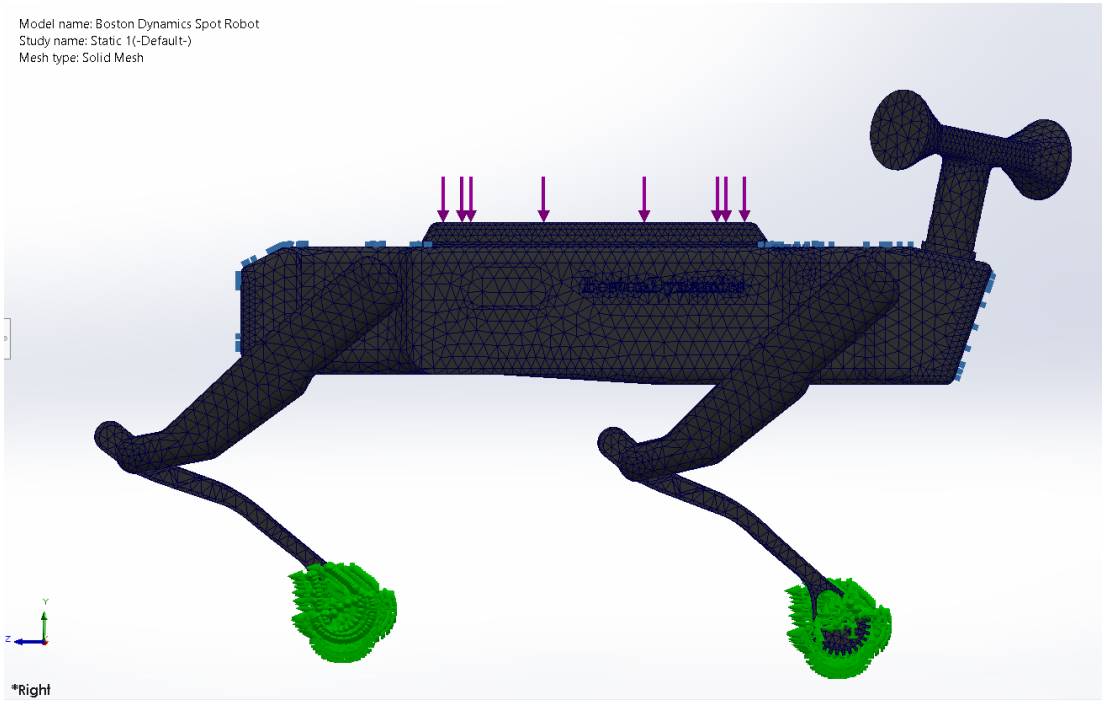


➢ FE Analysis :

1. Meshing :

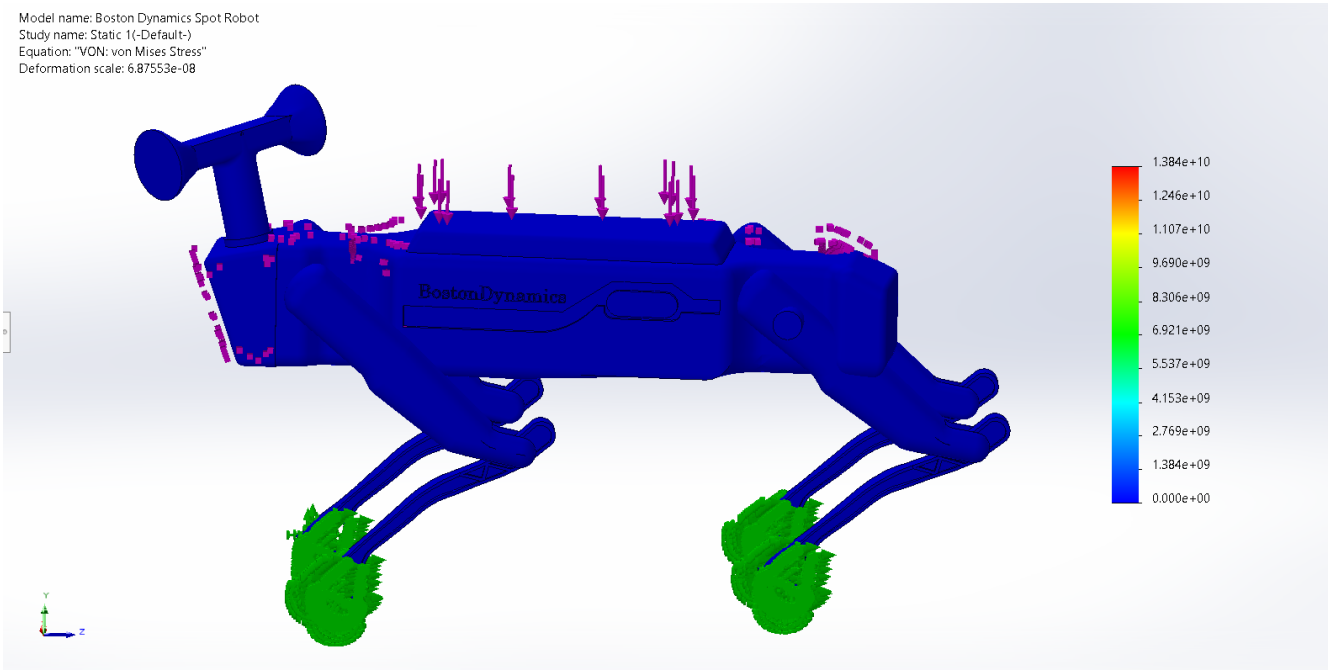
The generation of a solid mesh using SolidWorks software facilitates the meshing process, ensuring accurate and efficient analysis of the Boston Spot Robot's structural integrity and performance characteristics. The robot carries 10 kg payload means 98 Newtons weight following analysis is based on 98 N.
The solid mesh generation process in SolidWorks streamlines the preparation of the CAD model for computational analysis, providing engineers with valuable insights into stress distribution, deformation, and potential failure points.





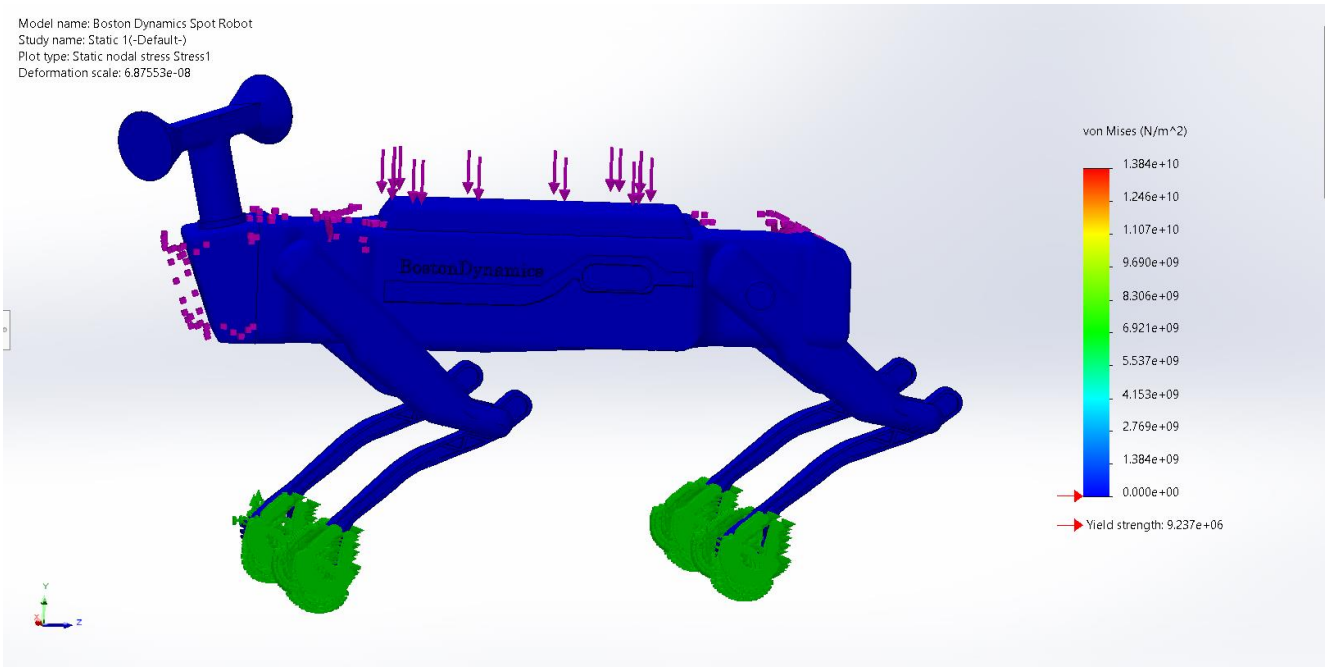
2. Stress (Von Mises) :

The application of stress analysis, specifically Von Mises stress calculations, plays a pivotal role in understanding the mechanical behavior of the Boston Spot Robot across varying operational scenarios. By employing this analytical method, we gain comprehensive insights into the distribution of stress throughout the robot's structure, allowing for the identification of critical areas prone to failure. Von Mises stress analysis conducted on the Boston Spot Robot revealed a maximum stress value of 1.384e+10 N/m^2 .It serves as a fundamental tool in assessing the structural integrity of the robot, ensuring that it operates within safe limits and mitigating the risk of mechanical failure. This analysis not only aids in optimizing the design of the Boston Spot Robot but also facilitates the implementation of necessary modifications to enhance its overall performance and durability. Incorporating Von Mises stress analysis into the design process underscores our commitment to engineering a reliable and robust solution capable of meeting the demands of real-world applications with confidence.



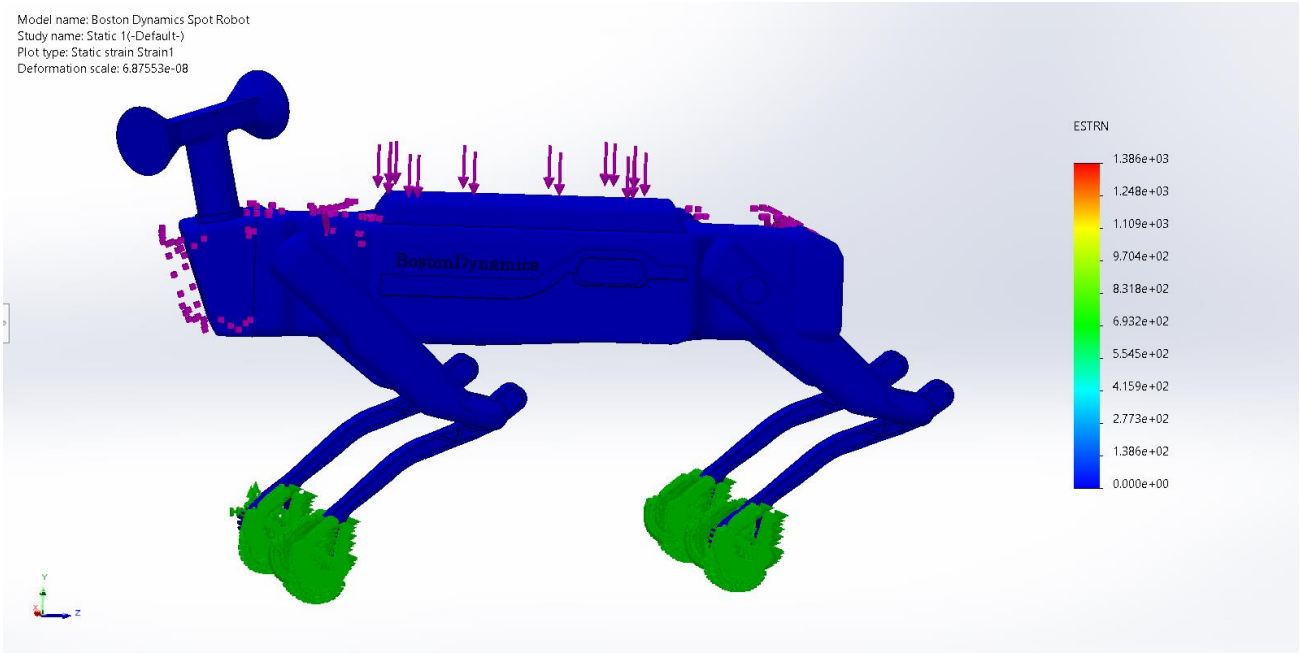
3. Static Nodal Stress :

The static nodal stress analysis conducted on the Boston Spot Robot revealed a maximum stress value of 1.384e+10 N/m^2. Comparatively, the yield strength of the material stands at 9.237e+06 N/m^2. This stark contrast indicates areas within the robot's structure operating under significant mechanical strain, potentially nearing or exceeding the material's yield limit. Such findings emphasize the criticality of design refinement and optimization to ensure structural integrity and operational safety. Addressing these stress concentrations through strategic modifications will be paramount in enhancing the robot's resilience and performance across a range of operational scenarios.



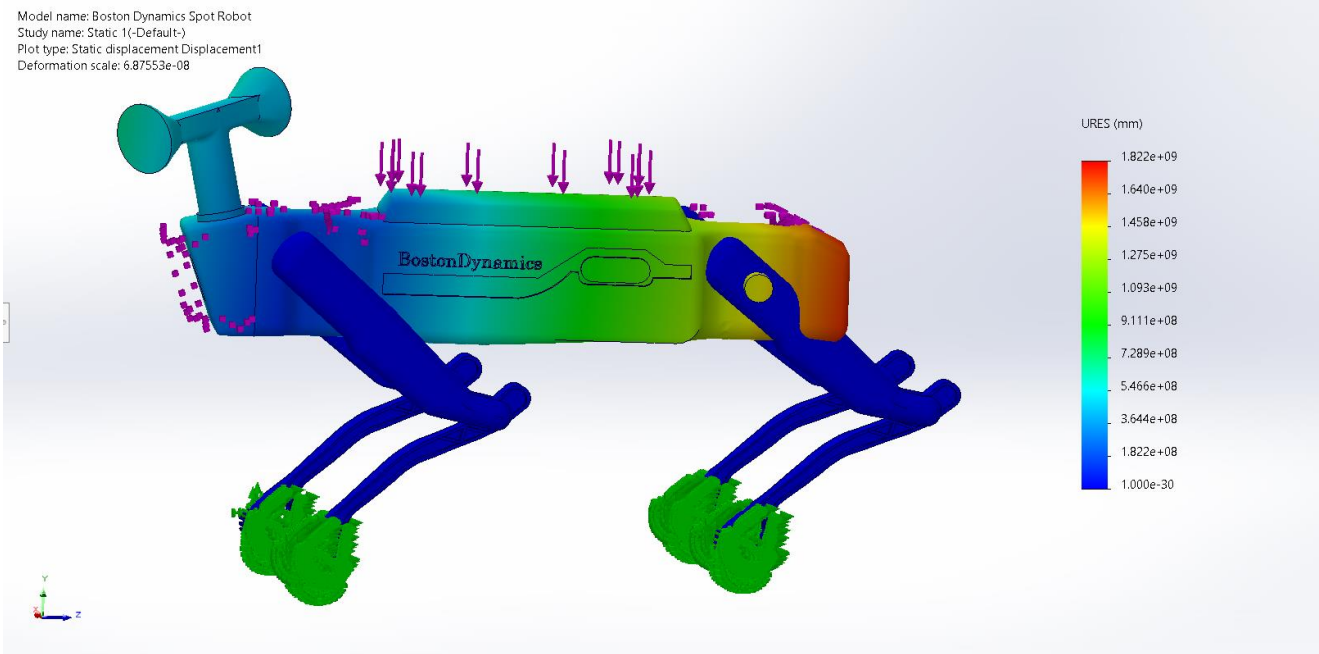
4. Static Strain :

The analysis of static strain in the Boston Spot Robot unveiled a maximum strain value of 1.386e+03 N/m^2. This metric provides valuable insights into the deformation behavior of the robot's structural components under applied loads. By understanding the distribution of strain, engineers can assess the material's response to mechanical forces and identify areas susceptible to excessive deformation or potential failure. Addressing these strain concentrations through design optimization and material selection is crucial for ensuring the long-term reliability and performance of the robot in real-world applications. By mitigating strain-induced vulnerabilities, we aim to enhance the overall durability and operational efficiency of the Boston Spot Robot.



5. Static Displacement :

The static displacement analysis conducted on the Boston Spot Robot revealed a maximum displacement value of 1.822e+09 mm. This metric provides crucial insights into the extent of deformation experienced by the robot's structural components under applied loads. Understanding the magnitude and distribution of static displacement is essential for assessing the robot's stability and structural integrity. By identifying areas of excessive displacement, engineers can refine the design and implement measures to minimize deflection, ensuring optimal functionality and performance. Addressing static displacement concerns is vital for enhancing the robot's reliability and effectiveness across various operational scenarios, contributing to its successful deployment in real-world applications.



➢ Conclusion :

In conclusion, the Boston Spot Robot represents a significant achievement in robotics engineering. Through meticulous design, analysis, and optimization, we have created a versatile and reliable platform capable of tackling a wide range of tasks. The robot's ability to climb stairs with a payload of up to 10 kg showcases its agility and strength, making it suitable for various industrial applications. Leveraging advanced analysis techniques, including stress, strain, and displacement analysis, we have ensured the robot's structural integrity and performance under diverse operational conditions. Moving forward, continued refinement and innovation will be essential to further enhance the robot's capabilities and adaptability for future challenges. With its demonstrated capabilities and potential, the Boston Spot Robot stands poised to make a significant impact in robotics and beyond.