# Article information:

An elastic–plastic analysis of spherical indentation: Constitutive equations for single-indentation unloading and development of plasticity due to repeated indentation - ScienceDirect  
<https://www.sciencedirect.com/science/article/pii/S0167663614000994>

# Article summary:

1. The unloading response of elastic-plastic materials indented by a rigid spherical indenter and the development of plasticity due to repeated indentation are examined through finite element simulations.

2. Equations for the dimensionless residual indentation depth and plastic work vs maximum indentation depth are extracted from finite element solutions, and constitutive contact equations are given for elastic-perfectly plastic and isotropic strain hardening materials subjected to indentation unloading.

3. The evolution of plasticity is tracked in four consecutive indentation cycles, with different behaviors observed depending on the effective elastic modulus-to-yield strength ratio and strain hardening exponent of the material being indented.

# Article rating:

May be slightly imbalanced: The article presents the information in a generally reliable way, but there are minor points of consideration that could be explored further or claims that are not fully backed by appropriate evidence. Some perspectives may also be omitted, and you are encouraged to use the research topics section to explore the topic further.

# Article analysis:

The article titled "An elastic-plastic analysis of spherical indentation: Constitutive equations for single-indentation unloading and development of plasticity due to repeated indentation" provides a detailed examination of the unloading response of elastic-plastic materials indented by a rigid spherical indenter. The study uses finite element simulations to analyze the behavior of materials with different effective elastic modulus-to-yield strength ratios and strain hardening exponents.

The article provides valuable insights into the mechanics of spherical contacts, which have numerous engineering applications. However, there are some potential biases and limitations in the study that need to be considered.

One limitation is that the study only examines the behavior of isotropic and kinematic strain hardening materials. Other types of material behavior, such as anisotropic or viscoelastic behavior, are not considered. This limits the generalizability of the findings to other types of materials.

Another limitation is that the study only examines repeated indentation up to four cycles. It is unclear how the behavior would change for a larger number of cycles or under different loading conditions.

Additionally, while the article provides equations for dimensionless residual indentation depth and plastic work vs maximum indentation depth, it does not provide experimental validation for these equations. Without experimental validation, it is unclear how accurate these equations are in predicting material behavior.

Furthermore, while the article provides valuable insights into the evolution of plasticity due to repeated indentation, it does not consider other factors that may affect material behavior under cyclic loading conditions, such as fatigue or creep.

Overall, while this article provides valuable insights into the mechanics of spherical contacts and plastic deformation due to repeated indentation, there are some limitations and potential biases that need to be considered when interpreting its findings.

# Topics for further research:

* Anisotropic material behavior in spherical indentation
* Viscoelastic response in spherical contacts
* Effects of cyclic loading on material fatigue and creep
* Experimental validation of residual indentation depth equations
* Behavior of materials under repeated indentation beyond four cycles
* Plastic deformation in non-elastic materials under spherical indentation.

# Report location:

<https://www.fullpicture.app/item/04b3f141a9a51c117148e67248a5a6d5>