

Tensor Calculus

An Introduction to Tensor Calculus

1. Why Tensor Calculus?
2. Geometric vectors as the starting point for Tensor Calculus. Vector-valued functions and more!
3. The Two Conflicting Definitions of the Gradient
4. Two Geometric Gradient Examples (Torricelli's and Heron's Problems)
5. The Covariant Basis
6. Change of Coordinates
7. The Tensor Notation
8. Position Vector, Covariant Basis, Covariant Metric Tensor, Contravariant Basis
9. A Few Tensor Notation Exercises
10. Quadratic Form Minimization
11. Decomposition by Dot Product in Tensor Notation
12. The Relationship Between the Covariant and the Contravariant Bases
13. Index Juggling
14. The Tensor Property
15. Invariants Are Tensors
16. The Christoffel Symbol
17. The Covariant Derivative
18. The Covariant Derivative 2
19. Velocity, Acceleration, Jolt and the New $\frac{\delta}{\delta t}$ -derivative
20. Determinants and Cofactors
21. Relative Tensors
22. The Levi-Civita Tensors
23. The Voss-Weyl Formula

24. [Embedded Surfaces and the Curvature Tensor](#)
25. [The Surface Derivative of the Normal](#)
26. [The Curvature Tensor On The Sphere Of Radius R](#)
27. [The Christoffel Symbol on the Sphere of Radius R](#)
28. [The Riemann Christoffel Tensor & Gauss's Remarkable Theorem](#)
29. [The Equations of Surface and the Shift Tensor](#)
30. [The Components of the Normal Vector](#)
31. [The Covariant Surface Derivative in Its Full Generality](#)
32. [The Normal Derivative](#)
33. [The Second Order Normal Derivative](#)
34. [Gauss' Theorema Egregium Part 1](#)
35. [Gauss' Theorema Egregium Part 2](#)
36. [Linear Transformations in Tensor Notation](#)
37. [Inner Products in Tensor Notation](#)
38. [The Self-Adjoint Property in Tensor Notation](#)
39. [Integration - The Arithmetic Integral](#)
40. [Integration - The Divergence Theorem](#)
41. [Non-hypersurfaces](#)
42. [Examples of Curves in 3D](#)
43. [Non-hypersurfaces - Relationship Among The Shift Tensors](#)
44. [Non-hypersurfaces - Relationship Among Curvature Tensors 1](#)
45. [Non-hypersurfaces - Relationship Among Curvature Tensors 2](#)
46. [Principal Curvatures](#)
47. [Geodesic Curvature Preview](#)
48. [Materials](#)

Essentials of Tensor Calculus

1. [A](#)
2. [B](#)
3. [C](#)
4. [D](#)
5. [E](#)

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