Laplacian

In mathematics the **Laplace operator** or **Laplacian** is a differential operator given by the divergence of the gradient of a function on Euclidean space. It is usually denoted by the symbols âˆ‡Â·âˆ‡, âˆ‡2 or Î”. The **Laplacian** Î”Æ’(p) of a function Æ’ at a point p, up to a constant depending on the dimension, is the rate at which the average value of Æ’ over spheres centered at p, deviates from Æ’(p) as the radius of the sphere grows. In a Cartesian coordinate system, the **Laplacian** is given by sum of all the (unmixed) second partial derivatives of the function. In other coordinate systems such as cylindrical and spherical coordinates, the **Laplacian** also has a useful form.

The **Laplace operator** is named after the French mathematician Pierre-Simon de Laplace (1749â€“1827), who first applied the operator to the study of celestial mechanics, where the operator gives a constant multiple of the mass density when it is applied to a given gravitational potential. Solutions of the equation Î”Æ’ = 0, now called Laplace's equation, are the so-called harmonic functions, and represent the possible gravitational fields in free space.

It occurs in the differential equations that describe many physical phenomena, such as electric and gravitational potentials, the diffusion equation for heat and fluid flow, wave propagation, and quantum mechanics. The **Laplacian** represents the flux density of the gradient flow of a function. For instance, the net rate at which a chemical dissolved in a fluid moves toward or away from some point is proportional to the **Laplacian** of the chemical concentration at that point; expressed symbolically, the resulting equation is the diffusion equation. For these reasons, it is extensively used in the sciences for modelling all kinds of physical phenomena. The **Laplacian** is the simplest elliptic operator, and is at the core of Hodge theory as well as the results of de Rham cohomology. In image processing and computer vision, the **Laplacian operator** has been used for various tasks such as blob and edge detection. Wikipedia - Laplacian