# The body heat energy identification and tracking as a signal ...

Author: A.M. Samuel

**Abstract:**

**Heat** is energy transferred from one system to another by thermal interaction. In contrast to work, heat is always accompanied by a transfer of entropy. Heat flow is characteristic of macroscopic objects and systems, but its origin and properties can be understood in terms of their microscopic constituents.

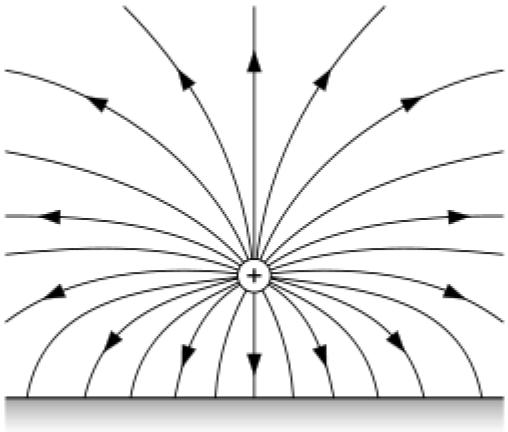
Heat flow from a high to a low temperature body occurs spontaneously. This flow of energy can be harnessed and partially converted into useful work by means of a heat engine. The second law of thermodynamics prohibits heat flow from a low to a high temperature body, but with the aid of a heat pump external work can be used to transport energy from low to the high temperature.

In ordinary language, heat has a diversity of meanings, including temperature. In physics, "heat" is by definition a transfer of energy and is always associated with a process of some kind. "Heat" is used interchangeably with "heat flow" and "heat transfer". Heat transfer can occur in a variety of ways: by conduction, radiation, convection, net mass transfer, friction or viscosity, and by chemical dissipation.

The SI unit of heat is the joule. Heat can be measured by calorimetry, or determined indirectly by calculations based on other quantities, relying for instance on the first law of thermodynamics. In physics, especially in calorimetry, and in meteorology, the concepts of *latent heat* and of *sensible heat* are used. Latent heat is associated with phase changes, while sensible heat is associated with temperature change.

An **electric field** is the region of space surrounding electrically charged particles and time-varying magnetic fields. The electric field depicts the force exerted on other electrically charged objects by the electrically charged particle the field is surrounding. The concept of an electric field was introduced by Michael Faraday.

## Introduction:



### Microscopic origin of heat

Heat is a macroscopic characteristic of systems, but like other thermodynamic quantities it has a microscopic explanation given by statistical mechanics. Temperature in many systems is the kinetic energy of motion of microscopic particles, and heat is the exchange of such energy. An early and vague expression of this was by Francis Bacon.

In signal processing, the **energy** $E_s$ of a continuous-time signal *x*(*t*) is defined as

$$E_s = \langle x(t), x(t) \rangle = \int_{-\infty}^{\infty} |x(t)|^2 dt$$

Energy in this context is not, strictly speaking, the same as the conventional notion of energy in physics and the other sciences. The two concepts are, however, closely related, and it is possible to convert from one to the other:

$$E = \frac{E_s}{Z} = \frac{1}{Z} \int_{-\infty}^{\infty} |x(t)|^2 dt$$

where *Z* represents the magnitude, in appropriate units of measure, of the load driven by the signal.

For example, if *x*(*t*) represents the potential (in volts) of an electrical signal propagating across a transmission line, then *Z* would represent the characteristic impedance (in ohms) of the transmission line. The units of measure for the signal energy $E_s$ would appear as volt$^2$-seconds, which is *not* dimensionally correct for energy in the sense of the physical sciences. After dividing $E_s$ by *Z*, however, the dimensions of *E* would become volt$^2$-seconds per ohm, which is equivalent to joules, the SI unit for energy as defined in the physical sciences.

### Spectral energy density

Similarly, the **spectral energy density** of signal x(t) is

$$E_s(f) = |X(f)|^2$$

where *X*(*f*) is the Fourier transform of *x*(*t*).

For example, if *x*(*t*) represents the magnitude of the electric field component (in volts per meter) of an optical signal propagating through free space, then the dimensions of *X*(*f*) would become volt-seconds per meter and $E_s(f)$ would represent the signal's spectral energy density (in volts$^2$-second$^2$ per meter$^2$) as a function of frequency *f* (in hertz). Again, these units of measure are not dimensionally correct in the true sense of energy density as defined in physics. Dividing $E_s(f)$ by $Z_o$, the characteristic impedance of free space (in ohms), the dimensions become joule-seconds per meter$^2$ or, equivalently, joules per meter$^2$ per hertz, which is dimensionally correct in SI units for spectral energy density.

### Parseval's theorem

As a consequence of Parseval's theorem, one can prove that the signal energy is always equal to the summation across all frequency components of the signal's spectral energy density.

### Energy in the electric field

The electrostatic field stores energy. The energy density *u* (energy per unit volume) is given by[4]

$$u = \frac{1}{2}\varepsilon|\mathbf{E}|^2,$$

where $\varepsilon$ is the permittivity of the medium in which the field exists, and **E** is the electric field vector.

The total energy *U* stored in the electric field in a given volume *V* is therefore

$$U = \frac{1}{2}\varepsilon\int_V |\mathbf{E}|^2\,\mathrm{d}V,$$

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## Electrodynamic fields

Electrodynamic fields are **E**-fields which do change with time, when charges are in motion.

An electric field can be produced, not only by a static charge, but also by a changing magnetic field. The electric field is given by:

$$\mathbf{E} = -\nabla\phi - \frac{\partial \mathbf{A}}{\partial t}$$

in which **B** satisfies

$$\mathbf{B} = \nabla \times \mathbf{A}$$

and ∇× denotes the curl. The vector field **B** is the magnetic flux density and the vector **A** is the magnetic vector potential. Taking the curl of the electric field equation we obtain,

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

which is Faraday's law of induction, another one of Maxwell's equations.

## The law

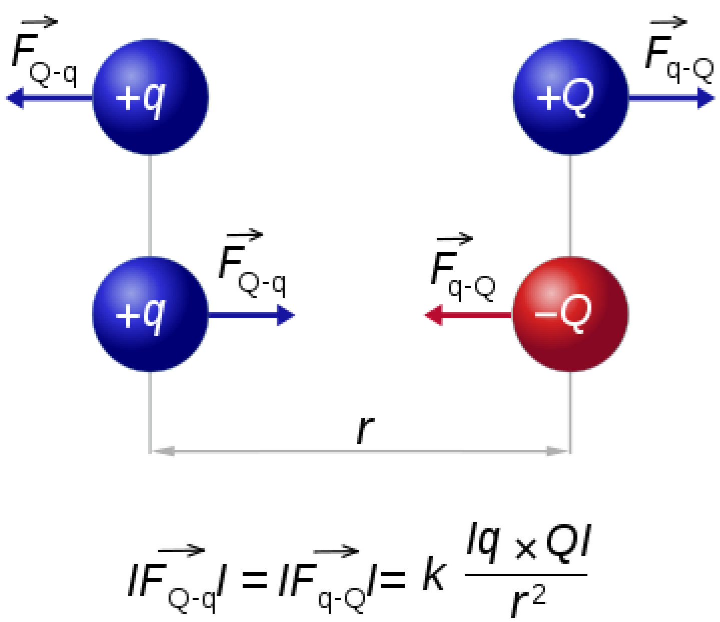


Diagram describing the basic mechanism of Coulomb's law. Like charges repel each other, opposite charges attract each other.

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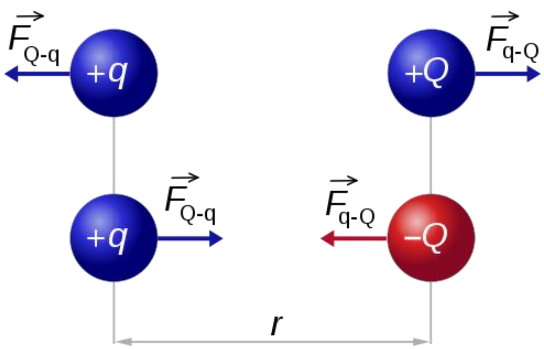
The scalar form of Coulomb's law is an expression for the magnitude and sign of the electrostatic force between two idealized point charges, small in size compared to their separation. This force ($F$) acting simultaneously on point charges ($q_1$) and ($q_2$), is given by

$$|\boldsymbol{F}| = k_e \frac{|q_1 q_2|}{r^2}$$

where $r$ is the separation distance and $k_e$ is a proportionality constant. A positive force implies it is repulsive, while a negative force implies it is attractive.[7] The proportionality constant $k_e$, called the Coulomb constant (sometimes called the Coulomb force constant), is related to defined properties of space and can be calculated based on the speed of light to be exactly:[8]

$$k_e = \frac{1}{4\pi\varepsilon_0} = \frac{c_0^2 \mu_0}{4\pi} = c_0^2 \cdot 10^{-7} \mathrm{H\ m^{-1}}$$
$$= 8.987\ 551\ 787\ 368\ 176\ 4 \cdot 10^9 \mathrm{N\ m^2\ C^{-2}}$$

Coulomb's law states that: "The magnitude of the Electrostatics force of interaction between two point charges is directly proportional to the scalar multiplication of the magnitudes of charges and inversely proportional to the square of the distances between them."



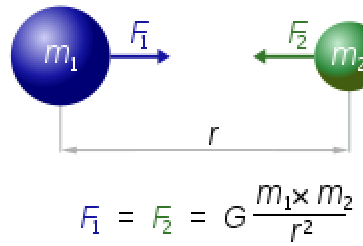

$$|\vec{F}_{Q\text{-}q}| = |\vec{F}_{q\text{-}Q}| = k \frac{|q \times Q|}{r^2}$$

**Newton's law of universal gravitation** states that every point mass in the universe attracts every other point mass with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. (Separately it was shown that large spherically symmetrical masses attract and are attracted as if all their mass were concentrated at their centers.) This is a general physical law derived from empirical observations by what Newton called induction.[2] It is a part of classical mechanics and was formulated in Newton's work *Philosophiæ Naturalis Principia Mathematica* ("the Principia"), first published on 5 July 1687. (When Newton's book was presented in 1686 to the Royal Society, Robert

Hooke made a claim that Newton had obtained the inverse square law from him – see History section below.) In modern language, the law states the following:

> Every point mass attracts every single other point mass by a force pointing along the line intersecting both points. The force is proportional to the product of the two masses and inversely proportional to the square of the distance between them:[3]

$$F = G\frac{m_1 m_2}{r^2},$$




where:

- $F$ is the force between the masses,
- $G$ is the gravitational constant,
- $m_1$ is the first mass,
- $m_2$ is the second mass, and
- $r$ is the distance between the centers of the masses.

Analysis:

Thus the Body heat energy source strength can be identified by the heat sensers and the signal strength can be identified and the signals can be tracked...

Every person has different heat energy output at different conditions , normal, running, walking etc... But the signals do follow a unique pattern for every person and can be collected as a unique signal ...

We can have heat sensors in the city like telecommunications towers and can track every persons het signal from his mobile only and can make a record of the persons heat flow and better analyze it and process it in a unique signal and thus a unique heat flow identification code of the person and the tracking and monitoring can be done too ....

Thus being in a heat flow monitored city and using the heat energy of the persons too as a entity of energy unit and tracking unit and processing unit.... Isn't it cool ...

Conclusion:

To use the Heat energy of the person as a unit of identification and tracking and monitoring, it will be better to safeguard the security of the lost and found and better understanding the people health status in terms of heat flow and energy requrements...

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