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# ON THE KÁRMÂN-HOWARTH EQUATION

(K URAVNENIIU KARMANA-KHOUARTA)

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Let us take the two points $x, y, z$ and $x, y', z$ in a Cartesian coordinate system. Let the nonsimultaneous velocity components at these points be $u(t)$, $v(t)$, $w(t)$ and $u'(t')$, $v'(t')$, $w'(t')$, respectively.

We can then write the Kármán-Howarth equation in the case of homogeneous isotropic turbulence in two ways

$$\frac{\partial}{\partial t}\langle vv'\rangle + \left[\frac{\partial}{\partial r} + \frac{4}{r}\right]\langle u^2v'\rangle = \nu\left[\frac{\partial^2}{\partial r^2} + \frac{4}{r}\frac{\partial}{\partial r}\right]\langle vv'\rangle$$

$$\frac{\partial}{\partial t'}\langle vv'\rangle - \left[\frac{\partial}{\partial r} + \frac{4}{r}\right]\langle u'^2v\rangle = \nu\left[\frac{\partial^2}{\partial r^2} + \frac{4}{r}\frac{\partial}{\partial r}\right]\langle vv'\rangle$$

Here

$$r = y' - y, \quad \langle vv'\rangle = \lim_{N\to\infty}\frac{1}{N}\sum_{n=1}^{N} v_n v_n'$$ ($n$ is the number of the experiment)

$$\langle u^2v'\rangle = f(r, t, t'), \qquad \langle u'^2v\rangle = -f(r, t', t)$$

These equations are independent, form a closed system, and permit elimination of the second moments. It follows that

$$\left[\frac{\partial}{\partial r} + \frac{4}{r}\right] f(r, t, t') = F(r, t, t')$$

$$\frac{\partial}{\partial t'} F(r, t, t') - \frac{\partial}{\partial t} F(r, t', t) = \nu\left[\frac{\partial^2}{\partial r^2} + \frac{4}{r}\frac{\partial}{\partial r}\right]\left[F(r, t, t') - F(r, t', t)\right]$$

is the functional differential equation in the third moments.

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