

论文

圆管湍流减阻电磁力控制的直接数值模拟

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收稿日期 2006-6-28 修回日期 2006-12-5 网络版发布日期 2007-5-15 接受日期

摘要 利用直接数值模拟研究了圆管湍流减阻的电磁力控制问题. 在圆管表面布置一层交替排列的条形电极和磁极, 施加电压后在导电的流体介质中产生周向随时间变化的电磁力, 通过改变电磁力的大小和变化周期等参数可以使阻力大幅减少. 研究减阻率和控制参数的关系, 并研究了电磁力减阻的机理. 电磁力控制存在最优周期, 阻力最大降低24.2%; 电磁力控制抑制了流向和法向速度的脉动, 而周向脉动速度随振荡周期的增大而增大.

关键词 [圆管](#) [湍流](#) [电磁力控制](#) [减阻](#)

分类号 [0361.5](#)

Direct numerical simulation of turbulent pipe flow controlled by MHD for drag reduction

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Abstract

We studied the MHD control of drag reduction in pipe flow through DNS. The Lorentz force is generated in the conductivity fluid by an array of electrodes and magnets fixed on the inner face of the pipe, when the voltage is applied on the electrodes. The drag is decreased numerously by changing the amplitude and the period of the force. We studied the relation between the ratio of drag reduction and the control parameters, and the physical mechanism is discussed additionally. The MHD control possesses the optimum period, the maximum drag reduction is 24.2%; The MHD control depresses the fluctuations of the streamwise and normal velocity, but the azimuthal velocity fluctuations grows with the increasing of the oscillatory period.

Key words [pipe](#) [turbulence](#) [MHD control](#) [drags reduction](#)

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