# CHAPTER V
# CONCLUSION

The results of our studies demonstrate the importance of polymer in drag reduction performance, especially in term of polymer/polymer and polymer/solvent interactions. Drag reduction enhancement is observed when polymer hydrodynamic radius is increased through polymer intermolecular association, by increasing molecular weight or by increasing polymer solvent interactions to yield an expanded chain. However, we are not able to show that $R_h$ is a universal scaling parameter for drag reduction performance for both unchanged and charged polymers.

The results of these studies further support a correlation between drag reduction parameters $l_d$ and $l_d/l_{do}-1$ and polymer hydrodynamic radius degree of polymerization and concentration. However, the scaling exponents obtained from the experiment differ from those predictive theories either by Lumley or de Gennes. Thus we propose a new viscoelastic theory in which all three forces, inertia force, viscous force and elastic force, are introduced into the scaling. The theory suggests two opposing roles for elasticity, the first is resisting eddy breakup which results in the elastic truncation while the latter effect is in storing of eddy kinetic energy which allows smaller eddies to survive against energy dissipation. The correlation between our viscoelastic length scale and $N$, $c_p$ in the non-dilute regime is derived to be, $l_k \propto \varepsilon^{-1} c_p^{3} N^{3}$. The approximate agreements with experimental data are obtained if we take '$a$' to lie between 0.2-0.3, depending whether we want to match concentration or degree of polymerization dependences more closely. The positive values of '$a$' imply that the storing of eddy kinetic energy by the elastic force is favorable. Small discrepancies between our theory and experimental data observed arise from polydispersity of the samples and the fact that experiments are carried out at finite Reynolds number. However, the

decrease in the concentration scaling exponent and the increase in the degree of polymerization exponent as Reynolds number increases are consistent with the scaling relation when '$a$' increases.