Exercise 2: Developing a Short Report Using a Graph with Two Scales

In this exercise, you are given part of an experimental data set. You are asked to prepare a graph presenting data using two scales, and to present that graph in a brief written report describing the project, the data, and the graph.

Objectives

The objective of this project is to characterize the flow of water through a small pipe, using measurements taken by a laser doppler velocimeter. Specifically, we want to characterize the velocity and turbulent intensity of the fluid flow at incremental distances measured across the diameter of the pipe.

Apparatus and Procedures

Figure 1 presents a general view of the fluid flow system of interest in this project, showing the system of pumps, reservoirs and valves that are used to adjust the velocity of the fluid flow and the pressures that it reaches. Figure 2 shows an inset of the measurement apparatus, showing the measurement pipe in cross section, along with the LDV apparatus. Measurements are taken in a line across the middle of the pipe at intervals of 0.05 inches, and these measurements capture the flow characteristics of the pipe at different flow velocities. For convenience, these measurements have already been converted to millimeters in the attached data table.

Assignment

The experimental measurements are shown in Table 1, and these results are graphed in Figure 3. Your task is to reproduce this graph using the data in Table 1. You are then to prepare a short report describing the project and presenting your results in both graphical and tabular form. The figures and table are to be inserted in the report electronically—scissors, tape and photocopying are not acceptable methods for preparing this report. In this report, you are also to make substantive observations about the data as reflected in the graph.

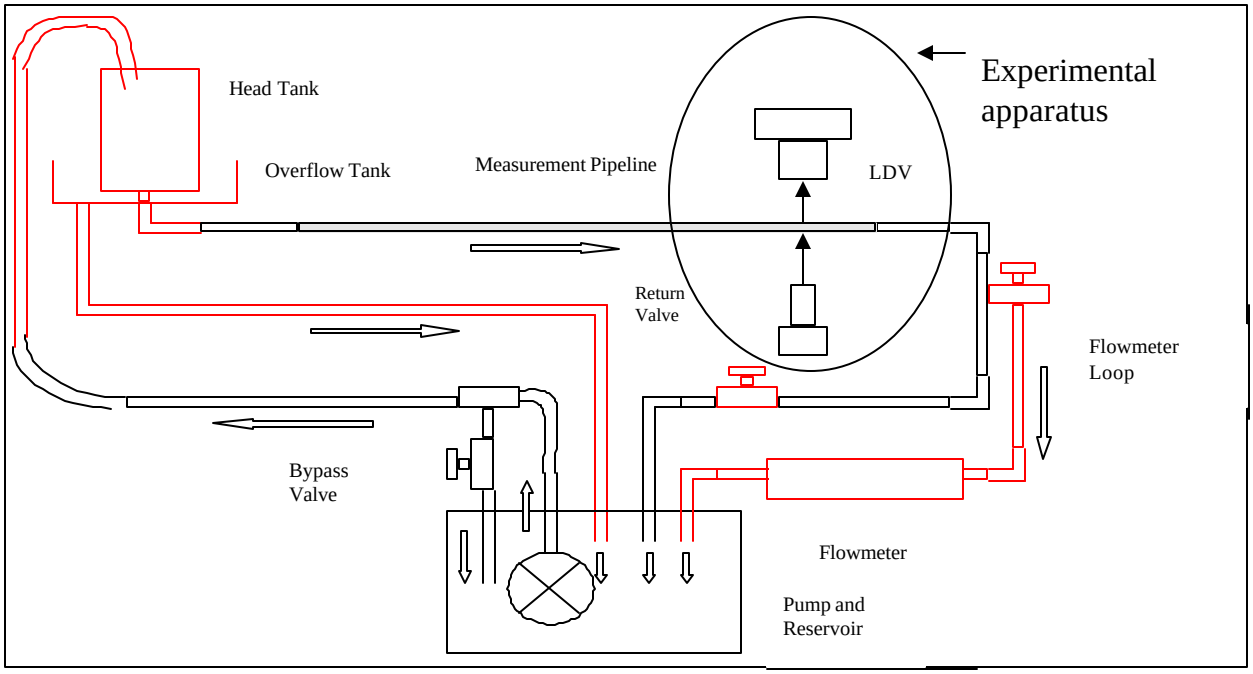

Figure 1. A complete fluid flow system, showing pump, valves, reservoir and flowmeter. The measurement pipe and LDV measurement apparatus are circled.

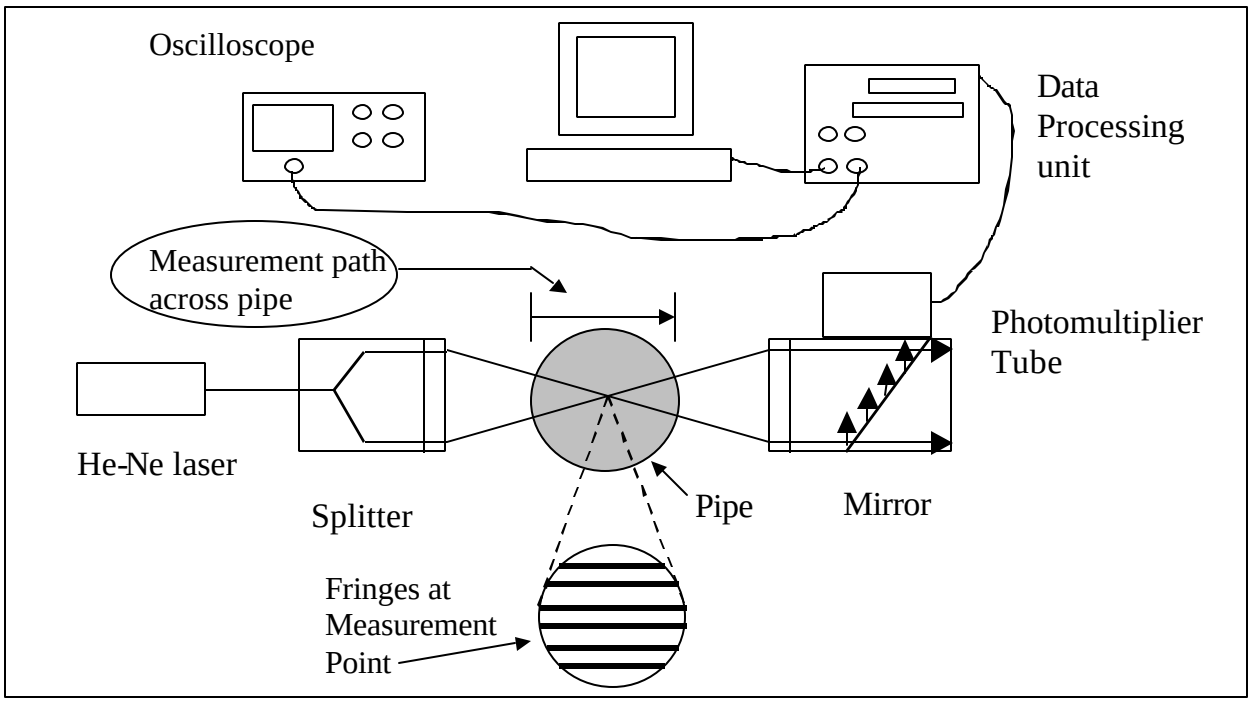

Figure 2. The LDV measurement system, showing the measurement pipe in cross section (gray).

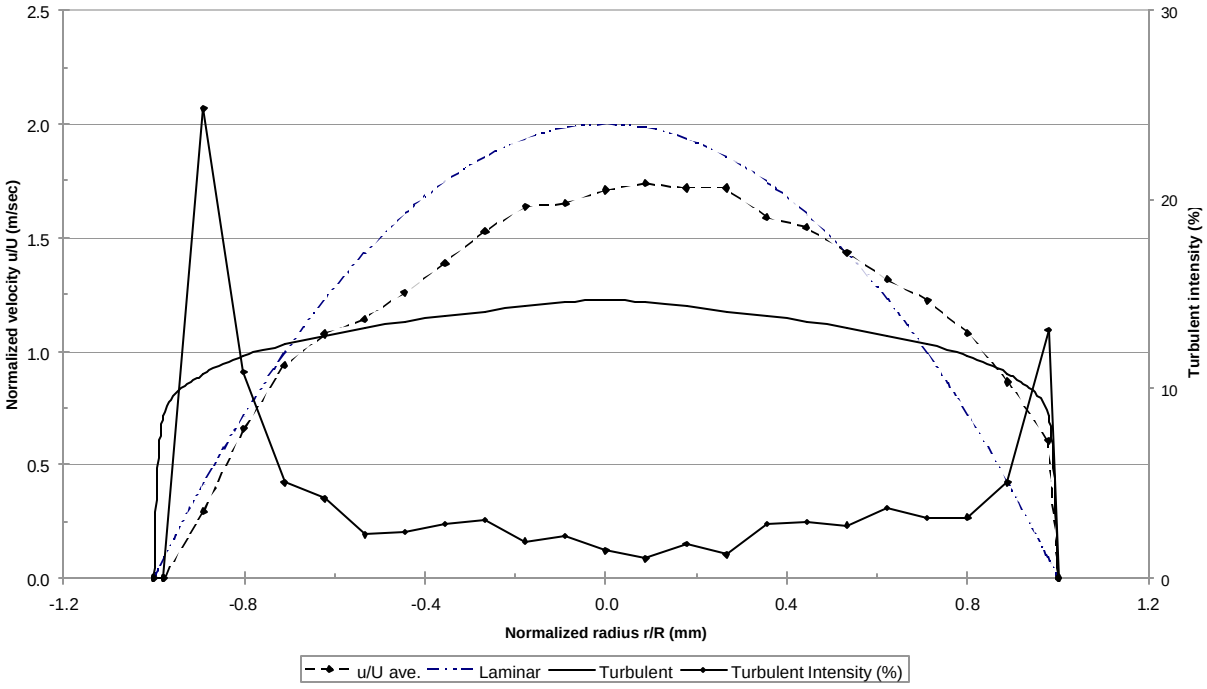

Figure 3. Flow profiles across the measurement pipe when Re = 1813. Normalized velocity, and turbulent intensity are plotted against normalized pipe radius, as are the turbulent and laminar models.

Table 1. Data for the LDV experiment.

r/R (mm)	Turbulent Intensity (%)	u/U ave. (m/sec)	Laminar flow model	Turbulent flow model
1.0000	0.0000	0.0000	0.0000	0.0000
0.9773	13.0933	0.6049	0.0896	0.7158
0.8884	5.0383	0.8634	0.4213	0.8988
0.7996	3.2188	1.0778	0.7214	0.9773
0.7107	3.1818	1.2236	0.9899	1.0299
0.6218	3.7094	1.3143	1.2268	1.0701
0.5329	2.7887	1.4353	1.4321	1.1029
0.4440	2.9557	1.5453	1.6057	1.1306
0.3551	2.8422	1.5893	1.7478	1.1549
0.2662	1.2258	1.7185	1.8583	1.1764
0.1773	1.8004	1.7185	1.9371	1.1957
0.0884	1.0118	1.7377	1.9844	1.2134
0.0000	1.4385	1.7102	2.0000	1.2295
-0.0893	2.2450	1.6497	1.9840	1.2132
-0.1782	1.9419	1.6360	1.9365	1.1955
-0.2671	3.0694	1.5288	1.8573	1.1762
-0.3560	2.8331	1.3858	1.7465	1.1546
-0.4449	2.4540	1.2593	1.6041	1.1304
-0.5338	2.2815	1.1411	1.4302	1.1026
-0.6227	4.1987	1.0751	1.2246	1.0697
-0.7116	5.0321	0.9349	0.9874	1.0295
-0.8004	10.9132	0.6571	0.7186	0.9767
-0.8893	24.8148	0.2942	0.4182	0.8978
-0.9782	0.0000	0.0000	0.0862	0.7117
-1.0000	0.0000	0.0000	0.0000	0.0000