CE640 / OC512 Matlab

Homework 6 – Parameter Estimation

There are many models for turbulent boundary layer flow. There is the classic smooth ‘log law’ equation, and a ‘rough wall’ equation. In the figure below, we see a velocity profile u(y). This could be water in a river flowing over the bed, or the wind blowing over the ground. In this assignment, you are to explore one possible curve fit to some experimental data.

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The data are given by:

|  |  |
| --- | --- |
| y (cm) | u (cm / s) |
| 0.073 | 57.12 |
| 0.44 | 75.78 |
| 0.81 | 83.77 |
| 1.19 | 89.58 |
| 1.56 | 94.16 |
| 1.93 | 97.99 |
| 2.3 | 100.81 |
| 2.67 | 102.13 |
| 3.04 | 102.62 |

1. The easiest model to apply is the ‘smooth log law, which states:

In this equation, u is the velocity (cm/s) in the x direction, y is the vertical coordinate (cm), u\* is the ‘shear velocity,’ (cm/s)  = 0.4 is the von Karman constant, and  is the kinematic viscosity of water. You can assume that  = 0.01 cm2 s-1. So, what is often done in open channel hydraulics is that the shear velocity is treated as a ‘fitting parameter.’ Just as we ‘fit’ a straight line to data by computing the best slope and intercept, we can ‘fit’ the log equation to data by figuring out the best shear velocity. So, that is your task! As a hint, you should come up with a shear velocity that is between 1 – 10 cm / s. Make a single figure that plots the data (as symbols only) and then your curve fit. Please add a title that displays the ‘best fit’ value (i.e. the number) of shear velocity.