Minion Ballast Scripts

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Contents

1 Introduction **1**

2 Minion Ballast Master **2**
2.1 Minion Parameters 2
2.2 Screw-up Factor 3

3 Minion Ballast inLab **3**

4 Minion Ballast atSea **4**

Abstract

This short report gives a detailed discription of the Minion Ballasting matlab scripts.

1 Introduction

The Minion is a subsurface float designed to sit at specific depths without needing to use any active form of propuslion. In order to achive this the Minions need to be ballasted for the correct depth; initial ballast experiments are run in a custom pressure tank and the height of the minion off the bottom is recored for each pressure. This data is necessary in order to use the minion scripts because we need to estimate the compressability of the Minion. In general we use two kinds of metal to ballast, lead and 316 stainless steel. Since it is easier to get very low mass 316, we get as close to the correct ballast weight with lead as we can, then use 316 to make up the rest. There are 3 main scripts

1. Minion Ballast Master

2. Minion Ballast inLab

3. Minion Ballast atSea

The user will only have to run the master script and it will need to be run 3 times in total. The other two files contain important functions that are used by Minion Ballast Master. In the master script there are 3 types of parameters; target parameters, chain parameters, and Minion parameters. The target parameters are to be set by the user before running the script. These are a guess at the conditions the minion will be deployed in, the defult settings are informed by an argofloat (link). The chain and Minion parameters are set before ballasting has occured. Every time the script is run, it will output 3 variables, although each run only one of them is actually relavent. The first time Minion Ballast Master is run it calculates the air weight of lead needed to properly ballast the Minion for the defult pressure, temperature, and salinity. This is the 'B lead' variable. After lead has been massed out to get as close as possible to this number, the air weight is set by the user to the lead sea variable and the script must be run again, this time the stainless sea variable is of interest and this is the amount of stainless needed to complete in lab ballasting, get as close as possible to this number without going over. Then The script needs to be run one last time at sea after a CTD as been preformed and true conditions are known.

2 Minion Ballast Master

2.1 Minion Parameters

There are several Minion parameters that need to be set before the main ballast script can be run. The user needs to input

1. 'm nolead' - air weight of Minion, g No lead

2. 'lead air' - air weight of lead added in tank, g

3. 'T tank' - tank temperature, C

4. 'S tank' - tank salinity, psu

5. 'pvec' - vector of pressures

6. 'cvec' - vector of links raised

Futher the user may ajust the bounds for *Pkeek* and *ckeep*, which are bounds for the data to be used for curve fitting. After all of the approprate info has been entered, the ballast master script should be run for the first time. There will be three variables output but at this point only 'b lead' is of concern. Lead should be massed out as close to this value as possible, then enter the amount of lead being added to 'lead sea' and run the program again; this time the 'stainless sea' output is of interest. this is the amount of 316 stainless needed to complete in lab ballasting. The actuall amount of 316 added should be as close to this value as possible without going over. However much is added should be recorded in 'stainless sea'. This completes in lab ballasting. When at sea the script will have to be run one last time with the appropiate condidtions set for 'P targ', 'T targ', and 'S targ'. Then when the script is run the 'nuts' output is how much the 316 ballast needs to change for the current condidtions.

2.2 Screw-up Factor

The screw-up factor should be commented out by defualt. It exists so that if the mass of the minion changes slightly after ballasting, the need to re ballast can be avoided. For example, if some of the sensors on the minion are changed after ballasting, screw-up factor can be uncommented and used to calculate the correct ballast. To use this part of the code, simply uncomment it and set 'm nolead ini' to the inital mass without lead of the minion. then simply use the code as before.

3 Minion Ballast inLab

P and C are vectors containg pressure and height data such that (P_i, C_i) is the i^{th} data point. We let P_{k} be the vector whos entries are an appropraite restriction of P we wish to fit and define C_{k} simillarly. First we fit a linear polynomial $\text{fit}(x)$ such that $\text{fit}(P_{\text{k}i}) \approx C_{\text{k}i}$. (more precisly the matlab function $\text{polyfit}(P_{\text{k}}, C_{\text{k}}, n)$ returns a list of coefficients of a polynomial of degree n, so in the matlab script $\text{fit}(P_i)$ would be written $P_i \cdot \text{fit}(1) + \text{fit}(2)$ where $\text{fit}(i)$ is the coefficient of x^{n+1-i}.)

We let $p_1 = 150$ and $p_2 = 300$ then $c_1 = (ml)\cdot\text{fit}(p_1)$ and $c_2 = (ml)\cdot\text{fit}(p_2)$ gives the water of the suspened chain.

Let ρ_{t1}, ρ_{t2} be the tank water density at p_1 and p_2 respectivily (in matlab $\rho_{ti} = \text{swdens}(S_t, T_t, p_i)$).

Now we wish to calculate the water weight of the temporary ballast given

its weight in air b_{temp},

$$b_t = b_{temp} \cdot (\frac{\rho_{316} - \rho_{t1}}{\rho_{316}}) + c_{\text{extra}}$$

4 Minion Ballast atSea