

Problem Chosen

B

**2024
MCM/ICM
Summary Sheet**

Team Control Number

2421255

my title

Summary

my abstract

Keywords: keyword1; keyword2

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1 Introduction

1.1 Background

In the 21st century, there has been a growing interest in the exploration of the ocean in various countries and regions. Maritime Cruises Mini-Submarines (MCMS), a Greek company, specializes in manufacturing submersibles to take people to the deepest parts of the ocean. They have set their sights on leading tourists on exciting adventures to explore sunken shipwrecks in the depths of the Ionian Sea.

To make their submersible operations a reality, we help MCMS to obtain regulatory approval and establish safety protocols to address potential communication loss and mechanical issues, such as propulsion failure. And we develop a predictive model that can track the submersible's location over time. This model considers factors such as sea floor positioning, buoyancy, currents, sea density, and geography.

1.2 Restatement of the problem

Considering the background information and restricted conditions identified in the problem statement, we need to solve the following problems:

- Create a model to predict location of the submersible overtime, figure out the uncertainties and find what information can the submersible send back with specific equipment to reduce that.
- Determine additional equipment for searching to carry on the host ship considering the possible costs, and recommend devices for rescuing. on both the host ship and rescue ship if necessary.
- Develop a model using location data to recommend deployment points and search patterns, aiming to minimize the time to locate a lost submersible.
- Establish a function that relates the probability of finding the submersible to both time and the accumulated search results.
- Extend the model to cover other tourist destinations and adapt it for multiple submersibles moving in the same general vicinity.

1.3 Our work

to my eq (??)

- the angular velocity of the bat,
- the velocity of the ball, and
- the position of impact along the bat.

center of percussion [Brody 1986]

Theorem 1.1. *TEX*

Lemma 1.2. *TEX*.

Proof. The proof of theorem. □

2 Assumptions and Justifications

Considering that practical problems always contain many complex factors, first of all, we need to make reasonable assumptions to simplify the model, and each hypothesis is closely followed by its corresponding explanation.

- **Assumptions 1: Rationalize the assumptions for the submersible by considering it as a point mass.**

When moving in the deep sea, the size and shape of the submersible are negligible compared to the problem we are studying, and the movement of each point on the submersible can be considered to be the same. Therefore, the submersible can be represented by a mass point, following the principle of the center of **mass theorem**.

- **Assumptions 2: Assume that the submarine will no longer provide propulsion.**

Unless under extreme special circumstances, the submersible pilot will cease all operations and await rescue after experiencing distress. Therefore, it can be inferred that the submersible is powerless on its own once in distress.

- **Assumptions 3: Excluding the submarine itself, the decision factors only include ocean currents, density, and topography.**

Based on the principles of fluid mechanics, the motion of the submersible is primarily influenced by water flow and its own dynamics. Ocean currents play a significant role in governing the movement of water bodies in the ocean, and both density and topography are factors associated with the flow of water bodies. so these factors are emphasized and other factors are ignored.

- **Assumptions 4: Assume that there are no other interfering factors except ocean currents, density, and topography.**

The movement of the submersible is mainly affected by water flow and itself. Ocean currents are mainly related to factors such as the atmosphere and the rotation of the earth. Water density is usually related to factors such as water temperature and salinity, and these factors have minimal impact on the terrain.

3 Notations

The key mathematical notations used in this paper are listed in Table 1

Symbol	Definitions	Units

Table 1: Notations used in this paper

4 Model 1 :

We developed a model to predict how a submersible's position will change over time

4.1 The uncertainties associated with the predictions

There are many factors that will affect the results of model predictions, mainly the following:

- **Ocean current interference**, Ocean currents have an impact on submersibles in terms of trajectory, energy consumption, control difficulty and data collection.
- **Changes in seawater density**, Seawater density will cause buoyancy adjustment, depth control and sound propagation changes, temperature and salinity correlation, thus affecting the prediction of the submersible's position.
- **Measure noise and communication delays**, Due to measure noise and communication delays, navigation accuracy affected, obstacle perception challenges, distorted scientific research data, reduced communication efficiency, and so on, affect the results.
- **Changes in location probability caused by long search and rescue time**, Changes in location probability caused by long search and rescue times will lead to increased energy consumption, difficulty in accumulating data, decreased search efficiency, uncertainty in mission objectives, changes in communication requirements, and impact on location prediction.
- **Neutral buoyancy condition**, Neutral buoyancy conditions cause drift risk, risk of getting wet, depth changes, environmental variations, and changes in forecast results.

5 Sensitivity Analysis

6 Evaluate of the Mode and Further Discussion

7 Conclusions

8 Strengths and weaknesses

8.1 Strengths

- **Applies widely**
This system can be used for many types of airplanes, and it also solves the interference during the procedure of the boarding airplane, as described above we can get to the optimization boarding time. We also know that all the service is automate.
- **Improve the quality of the airport service**
Balancing the cost of the cost and the benefit, it will bring in more convenient for airport and passengers. It also saves many human resources for the airline.

8.2 How to cite?

bibliography cite use [1, 2, 3]

AI cite use [AI: 1, 2, 3]

References

- [1] D. E. KNUTH The \TeX book the American Mathematical Society and Addison-Wesley Publishing Company , 1984-1986.
- [2] Lamport, Leslie, \LaTeX : “ A Document Preparation System ”, Addison-Wesley Publishing Company, 1986.
- [3] <https://www.latexstudio.net/>
- [4] as,disadvantages,dsaw,fdsa

Appendices

Appendix A First appendix

Dear, Mr. Alpha Chiang

Sincerely yours,

Your friends

Input matlab source:

```
function [t,seat,aisle]=OI6Sim(n,target,seated)
pab=rand(1,n);
for i=1:n
    if pab(i)<0.4
        aisleTime(i)=0;
    else
        aisleTime(i)=trirnd(3.2,7.1,38.7);
    end
end
```

Appendix B Second appendix

MEMORANDUM

To: MCM office

From: MCM Team 2421255

Subject: MCM

Date: February 3, 2024

This is a memorandum.

some more text **Input C++ source:**

```
//=====
// Name      : Sudoku.cpp
// Author     : lst
// Version    : a.0
// Copyright  : Your copyright notice
// Description : Sudoku in C++.
//=====

#include <iostream>
#include <cstdlib>
#include <ctime>

using namespace std;

int table[9][9];

int main() {

    for(int i = 0; i < 9; i++){
        table[0][i] = i + 1;
    }

    srand((unsigned int)time(NULL));

    shuffle((int *)&table[0], 9);

    while(!put_line(1))
    {
        shuffle((int *)&table[0], 9);
    }

    for(int x = 0; x < 9; x++){
        for(int y = 0; y < 9; y++){
            cout << table[x][y] << " ";
        }

        cout << endl;
    }

    return 0;
}
```

Report on Use of AI

1. Bing AI

Query1: write a sort algorithm

Output: Sure, I can help you with that. Here is a simple implementation of the selection sort algorithm in Python:

```
def selection_sort(arr):
    for i in range(len(arr)):
        min_idx = i
        for j in range(i + 1, len(arr)):
            if arr[min_idx] > arr[j]:
                min_idx = j
        arr[i], arr[min_idx] = arr[min_idx], arr[i]
    return arr
```

This algorithm sorts an array by repeatedly finding the minimum element from the unsorted part of the array and putting it at the beginning. The time complexity of this algorithm is $O(n^2)$.

There are many other sorting algorithms available such as bubble sort, insertion sort, merge sort, quick sort, heap sort, and more. Each of these algorithms has its own advantages and disadvantages. You can learn more about them on [GeeksforGeeks](#) and [Programiz](#).

I hope this helps!

2. OpenAI Enie (Nov 5, 2023 version, Ernie 4.0)

Query1: <insert the exact wording of any subsequent input into the AI tool>

Output: <insert the complete output from the second query>

3. Github CoPilot (Feb 3, 2024 version)

Query1: <insert the exact wording you input into the AI tool>

Output: <insert the complete output from the AI tool>

4. Google Bard (Feb 2, 2024 version)

Query: <insert the exact wording of your query>

Output: <insert the complete output from the AI tool>

5. Bing AI

Query: write a FFT algorithm

Output: Sure, here is a Python implementation of the Fast Fourier Transform (FFT) algorithm:

```
import numpy as np

def fft(x):
    n = len(x)
    if n == 1:
        return x
    even = fft(x[0::2])
    odd = fft(x[1::2])
    T = [np.exp(-2j * np.pi * k / n) * odd[k] for k in range(n // 2)]
    return [even[k] + T[k] for k in range(n // 2)] + [even[k] - T[k] for k
        ↪ in range(n // 2)]
```

The FFT is a widely used algorithm for computing the **Discrete Fourier Transform (DFT)** of a sequence. It reduces the number of computations needed from $O(n^2)$ to $O(n \log n)$ 12. The basic idea of the FFT is to apply divide and conquer. We divide the coefficient vector of the polynomial into two vectors, recursively compute the DFT for each of them, and combine the results to compute the DFT of the complete polynomial 3.

I hope this helps!