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ALGORITHM AND SOFTWARE IMPLEMENTATION OF INTERNATIONAL METEOROLOGICAL CODES DECODING METHOD

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Abstract. *An algorithm that can decode the international meteorological code METAR considering all code elements has been developed. The software implementation of methods for the international meteorological code METAR decoding and its representation in understandable for any user format has been created.*

Keywords: algorithm; algorithm and software implementation; decoding method; international meteorological code; METAR code; meteorological data; weather information.

1. Introduction

The number of aviation accidents and incidents due to the unfavorable or dangerous meteorological conditions increased recently.

The special place among them is taken by light and superlight aircraft that execute flights from unequipped aerodromes, helipads, etc.

The reason of such accidents and incidents is lack of data about the weather on the aerodrome and weather conditions during the all flight.

Meteorological information can be received according to the rules of the air in the class G, through the channel "air-ground" upon request, channel of meteorological broadcasting and using the internet.

The main problem is that the pilot (amateur in our case) faces with misunderstanding of meteorological code and the air traffic controller, furthermore, with the difficulties of data transmission through the communication channel.

One of the ways to provide weather information is METAR (aerodrome routine meteorological report). METAR is the most popular format in the world for the transmission of weather data.

It is highly standardized through the International Civil Aviation Organization (ICAO).

A typical METAR contains data for the temperature, dew point, wind speed and direction, precipitation, cloud cover and heights, visibility, and barometric pressure, precipitation amounts, lightning.

The code also may include some additional information (runway state, etc.) and other information that would be of interest to pilots for performing the flight. All this data should be given in the specified order.

A METAR weather report is basically used by pilots during the pre-flight weather briefing, and by meteorologists, who use assembled METAR information to assist in weather forecasting.

To help them the program realization was created which simplifies understanding of encoded information.

2. Literature Analysis

Nowadays there exists such literature and documents concerning rules of meteorological codes construction and decodings.

This work deals with "Terms of aviation meteorological service"[2].

Main rules of meteorological codes representation are described at the Document 8896 "Manual of aeronautical meteorological practice" [1].

Current work in also based on Document 7910 "Location indicators" [4] and "Algorithm and software implementation of international code METAR decoding method" [3].

3. The goal of the work

After the analyzing of incidents and accidents investigations, the aim of creation algorithm and software realization, which is supporting in understanding of weather information, has appeared.

This is the first software with Russian library that decodes international meteorological codes to Russian language properly, that is at the same time highly helpful for Russian – speaking aviation personnel.

4. METAR information and structure

The METAR code form was developed by World Meteorological Organization on the basis of aeronautical requirements established by ICAO.

This code uses the approved ICAO abbreviations contained in the Procedures for Air Navigation Services – ICAO Abbreviations and Codes (PANS-ABC, Doc 8400).

Units of measurement differ in some States depending on national practices. In this work, all units used are those prescribed by Annex 5 – Units of Measurement to be Used in Air and Ground Operations as primary or alternative units.

As regards elements for which two units are permitted, numerical criteria are given for both units, and examples of reports are given in one or the other unit.

METAR consists of several parts following the special sequence. Such parts should be separated:

– identification of the type of report (METAR);

– location indicator (e.g. "YUDO"):

ICAO four-letter location indicator for the aerodrome for which the report is made.

The full name of the aerodrome is used in the transmission to aircraft.

The indicators are prescribed in Doc 7910 – Location Indicators;

– time of the observation (e.g. "221630Z"):

Day and actual time of observation: day of the month and time in hours and minutes, in Coordinated Universal Time (UTC);

– identification of an automated report (AUTO):

In the case of METAR from automatic observing systems with no human intervention, the report is to be identified with "AUTO";

– surface wind (e.g. "21005MPS"):

First three numbers – wind direction, next two – wind speed and units of measurement;

– significant speed and directional variations:

Variations of wind direction and speed given in meteorological reports always refer to the ten-minute period preceding the observation.

There such indications:

a) the mean speed is 1.5 m/s (3 kt) or more and the wind direction varies by less than 180°: 01009KT 350V050;

b) the mean speed is less than 1.5 m/s (3 kt) and the wind direction varies by less than 180°: VRB01MPS;

c) the wind direction varies by 180° or more:

VRB05MPS;

– visibility (e.g. "0600"):

Four numbers should indicate visibility in meters;

– runway visual range (RVR) (e.g. "R10/2000U"):

In this part the runway designation and RVR are described;

– present weather (e.g. "FZ DZ").

All weather phenomena are indicated by corresponding abbreviations. For example, "DZ" means "Drizzle";

– cloud (e.g. "SCT010 OVC020"):

Cloud amount and cloud base are described by means of corresponding abbreviations and numbers;

– air temperature/dew-point temperature (e.g. "17/16"):

Air temperature and dew point temperature values are reported in METAR in two figures separated by "/", e.g. air temperature of +17.4 and dew-point temperature of +15.7 are reported as "17/16".

Temperatures below 0°C are preceded by M (meaning minus). Temperatures in the range of –0.5°C to –0.1°C are reported as "M00", while temperatures in the range of 0.0° to 0.4°C are reported as "00";

–atmospheric pressure (e.g. "Q1016"):

In METAR, atmospheric pressure is given in hectopascals, rounded down to the nearest lower whole hectopascal and reported in four figures, e.g. QNH 1011.4 is reported as "Q1011" .

–supplementary information:

In METAR, two additional groups may be included as supplementary information:

a) information on sea-surface temperature and the state of the sea at aeronautical meteorological stations established on offshore structures in support of helicopter operations;

b) information on the state of the runway(s).

Software implementation of considered code (METAR in this example) requires the development of algorithm which allows to analyze elements of inputted meteorological code, identify each element separately and find corresponding decoding to one.

Obtained results are displayed in corresponding sequence and correct view.

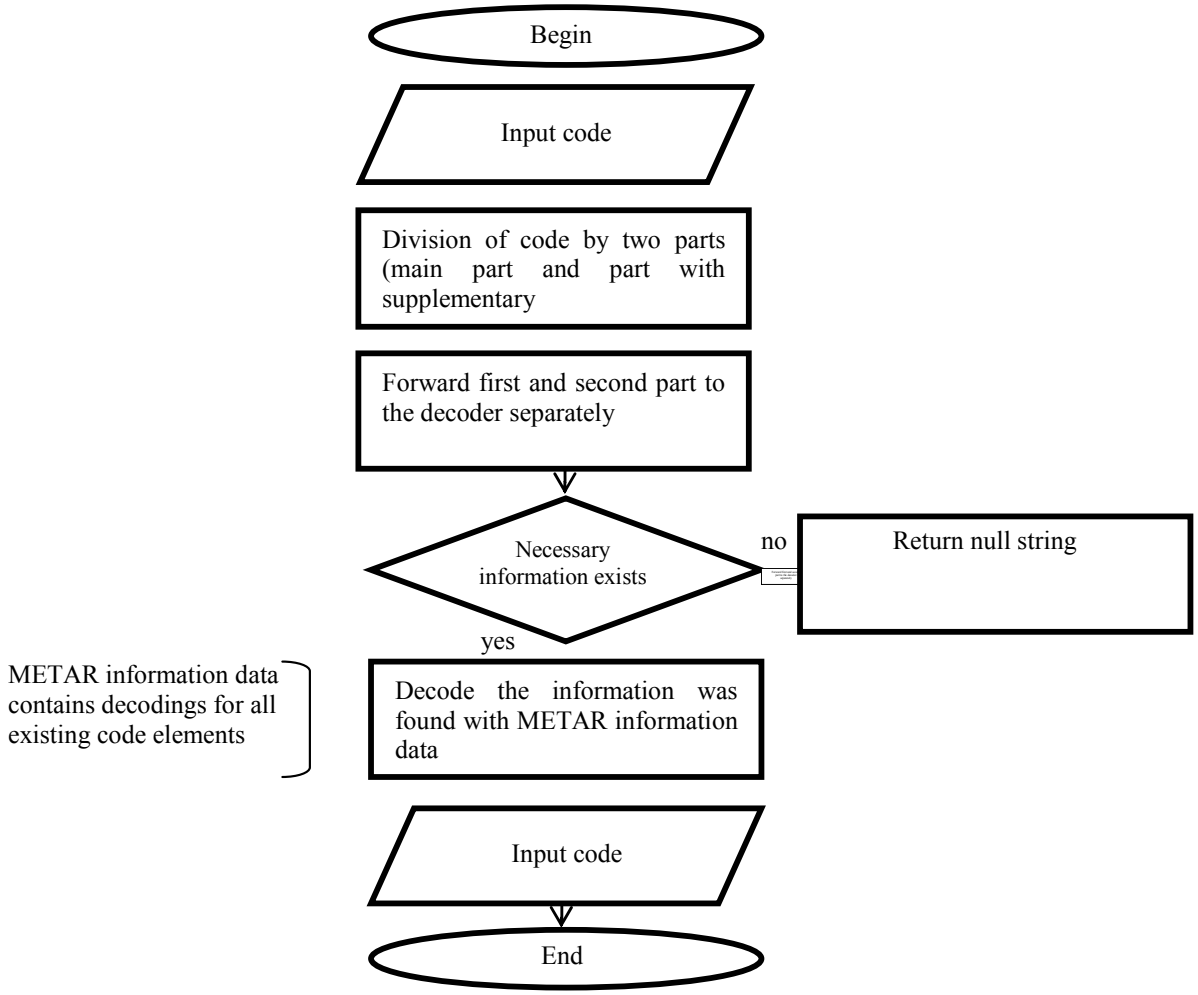
There was created algorithm for meteorological codes decoding. The algorithm for METAR code is represented below (see Figure) as an example.

Developed algorithm was used for software implementation. Programming language C# and programming environment Microsoft Visual Studio 2010 have been used to write the program.

The program has an interactive interface that allows the user to enter the decoded METAR or to download it from the computer in .txt format.

Further the program begins to read entered code from the beginning to end. Table with example of input METAR data is given in Table.

Then it finds known elements and assigns to them correct meanings.



The program algorithm

Finally, the program gathers all received information and outputs decoded METAR in the corresponding window.

Interface of the program includes two windows (with encoded METAR and decoded METAR) and two buttons (to open file with encoded METAR and to decode METAR). After the program loading, any file with METAR can be opened and, using algorithm described here, program will decode METAR and show the result for user at the window.

METAR code

METAR
LOWW 221830Z 31015G30KT
3000 1400E R16/P2000D +SHRA
FEW005 BKN020CB OVC100 26/21
Q0991 WS R16 R16/290335 BECMG
FM1930 9999 NSW SCT030CB

5. Conclusions

This algorithm and software implementation simplifies the work of meteorologists, ATCs and is helpful for pilots, especially amateurs, in understanding aerodrome weather information precisely without any difficulties connected with decoding.

Moreover, realization of decoding to Russian language neutralizes problem of imperfect English among amateur pilots and elderly pilots with long record of service.

Furthermore, on the base of created program, decoding software can be realized not only for METAR but also for all such meteorological codes.

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С.М. Креденцар[1], С.І. Рудас[2], Г.М. Івлєва[3]. Програмно-алгоритмічна реалізація методу розшифрування міжнародних метеорологічних кодів

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Розроблено алгоритм, що дозволяє розшифрувати міжнародний метеорологічний код METAR, розглядаючи кожен з елементів коду. Виконано програмну реалізацію методів розшифрування міжнародного метеорологічного коду METAR і подання його в зрозумілому для будь-якого користувача вигляді.

Ключові слова: алгоритм; інформація про погоду; код METAR; метеорологічні дані; метод розшифрування; Міжнародний метеорологічний код; програмно-алгоритмічна реалізація.

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Разработан алгоритм, позволяющий расшифровать международный метеорологический код METAR, рассматривая каждый из элементов кода. Выполнена программная реализация методов расшифровки международного метеорологического кода METAR и представления его в понятном для любого пользователя виде.

Ключевые слова: алгоритм; информация о погоде; код METAR; Международный метеорологический код; метеорологические данные; метод розшифровки; программно-алгоритмическая реализация.

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