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MEASURING DEVICE FOR 3D PROPELLER GEOMETRY

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ABSTRACT
This work represents a brief representation review of the measuring device for propeller 3D measurement. It includes the measuring procedure, the measuring device architecture, the program on PC for 3D model generation and the directions for the future development

KEY WORDS:
measuring machine, 3D modell

1. INTRODUCTION

Maximal ship propeller push is realized thanks to its perfect geometry. Concerning this, there was necessity for measuring equipment that would serve for the propeller geometry measurement in three dimension. The benefits should appear with not only the new propeller production, but also from the geometry correction of used ones, during the ship repairment.

Using the measured data in three axes, and appropriate program, it is possible to get a whole picture of the measured propeller geometry. Specific features that introduce this project is high measuring accuracy (5 micron) and constant data flow to the processing program on the PC, where will be used for the 3D model.

2. SYSTEM ARCHITECTURE

Measuring system is comprised from the three basic parts:

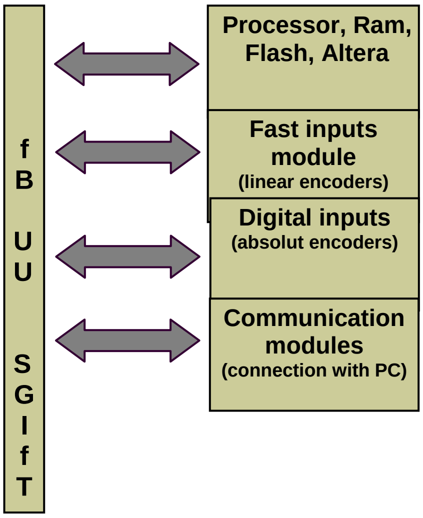
- Mechanical part;
- Electrical measuring device with adequate encoders;
- Program on the PC.

2.1. MECHANICAL SYSTEM FOR 3D GEOMETRY MEASUREMENT

During the construction of the mechanical part of the measuring system, it was necessary to determine number and different types of movement during the measuring process, so the spacial propeller geometry could be successfully described. With the detail analysis the conclusion came that the adequate propeller geometry measurement need to have three degrees of freedom, two linear and one rotational.

2.2. ELECTRICAL DEVICE FOR MEASURING WITH ADEQUATE ENCODER DEVICES

Specific features that system comprises are specially in electrical measuring device, that needs to enable precision of 5 microns and also, the permanent data flow to the serial PC port. Analysing the measuring devices currently on the market, the conclusion came that there was no device that could satisfy given tasks, and in the same time enter the provided budget. Concerning this facts, on the Department for Automation and Control Systems which is a part of the Electrotechnical Faculty in Novi Sad, the design and the construction for the specific propeller geometry measurement device started, and also the PC program for data analysis and 3D model creation.



Picture 1. Measuring device architecture

Picture 1 shows the measuring device architecture. Measuring device is, in the fact, standard programmable logical controller (PLC), with special modules needed for high precision measurement tasks. For the proper encoder reading, the two possible solutions could be chosen: position controllers LM628 or using the fast inputs. The more economical solution was using the fast inputs to connect the encoders.

Specific fast inputs on the device are able to accept extremely high input frequences - up to 1MHz, comparing to standard fast inputs that are able to withstand up to 10KHz. Thanks to this feature, it is possible to have very high measuring speeds, with high accuracy up to 1 micron. The high speed inputs are connected with linear encoders. For the rotational propeller movement registration, the absolute rotational encoder is used. Reading the current position is made possible by the benefit of 12-bit Gray code. The reading is parallel on 12 digital inputs.

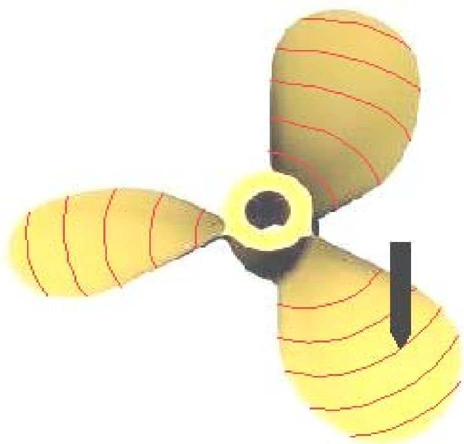
The device is based on Intel 386EX processor, has the 512KB working and Flash memory. For hardware operation definition the Max Altera programmable logic is used. For communication with PC computer, measuring device has two serial ports. One provides control software downloading, and another is used for real time communication (measured data transfer). Apart the mentioned digital inputs for absolute encoder position reading, the measuring device has another two inputs, first for measurement and data transfer start, and second for resetting the linear encoder counters.

Control software for the device was made by using the CoDeSys programming environment and the Structured Text, that complies with IEC61131-3 standard. Program scans the fast input counters, and their value forwards to the serial port. Absolute position on the rotational axes needs to be calculated from the state of 12 inputs, after decoding the 12-bit Gray code into the decade system.

2.3. PERSONAL COMPUTER PROGRAM FOR DATA ARRANGEMENT AND 3D MODEL CREATION

Program is realized in Delphi programming environment, using the special 3D modeling components. These components use given points with spacial coordinates to generate 3D model. Fundamental application of this program is defect tracing in propeller geometry that's being measured. There are three basic working regimes:

- Data reception through the RS232 port.
- Data processing and 3D model generation by use of the gathered data.
- Analyse and comparison of the generated with ideal 3D propeller model geometry.



Picture 2. Propeller geometry measuring procedure

In the reception mode, program gathers the data from the measuring device through the serial port. For the reliable 3D model generation, during the measuring process, the specific precisely defined procedure should be followed. The measuring procedure considers commited definition of the beginning and the end of each propeller blade, in every section, as shown on picture 2.

With the gathered data, specific mathematic apparatus, charactersitic for 3D model propeller, is used for 3S model creation. Comparing the measured model with the ideal 3D model, with the same technical characteristics, eventual deviations could be easily spotted. These information are then used to determine the optimal procedure for the measured propeller geometry correction. This could be accomplished by applying the additional material on the damaged surface or removing the excessive material from the propeller.

3. FURTHER DEVELOPMENT

Further steps should include measuring machine adaptation for different object types.

Observing from the control hardware aspect, conclusion could be made that there are no limits, concerning the fact that hardware is capable of processing up to five axes simultaneously.

Program on the PC also does not need major corrections.

Major changes are therefore needed in the mechanical construction of the machine.

4. LITERATURE

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