# UZAYBİMER RADIO TELESCOPE CONTROL SYSTEM

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#### RESUMEN

Un radar de 13m inicialmente propiedad de la OTAN está siendo reconvertido a radiotelescopio. El radiotelescopio está controlado por un sistema desarrollado en UZAYBIMER. El Sistema de Control del Telescopio (TCS) ha sido diseñado usando sistemas industriales modernos. TCS ha sido desarrollado en LabView con un sistema operativo Windows. El posicionamiento usado en radiotelescopios es un estándar industrial EtherCAT. La librería ASCOM es usada para cálculos astronómicos.

### ABSTRACT

A 13 meters former NATO radar is being converted into a radio telescope. The radio telescope is controlled by a system which has been developed at UZAYBİMER. The Telescope Control System(TCS) has been designed using modern industrial systems. TCS has been developed in LabView platform in which works Windows embedded OS. The position feedback used on radio telescopes is an industrial EtherCAT standard. ASCOM library is used for astronomical calculations.

*Key Words:* telescopes

## 1. UZAYBİMER

UZAYBİMER (Astronomy and Space Sciences Observatory Application and Research Center) is an astronomical observatory in Kayseri/Turkey (http://uzaybimer.erciyes.edu.tr/). UZAYBIMER will carry out fundamental researches and applications about radio and optical astronomy. Additionally, UZAYBIMER is the first and only Radio Astronomy Observatory of Turkey. The Center, whose main research area is radio astronomy, is intending to be and provide a research and application and education place for professionals and academicians and students and public in the field of radio and optical astronomy. The idea of an observatory and research center developed simultaneously with the establishment of the Astronomy and Space Sciences Department in Science Faculty.

#### 2. RADIO TELESCOPE

- Main reflector: 13 meters
- Secondary ref.: 1.4 meters
- Antenna Gain: 44 dB at 1420 Mhz
- Focal (f/D) : 0.319
- Panels: 64 pieces
- Mount: Alt-Az
- Weigth: 5400 kgs
- Frequencies: 13.36 MHz 13.41 MHz, 25.55 MHz - 25.67 MHz (Solar), 400.00 MHz - 410.00 MHz (Pulsar), 1400 MHz - 1427 MHz (HI)



Fig. 1. The Radio Dome of 13m dish, outside view.

# 3. RADIO EQUIPMENTS

- Telescope Control IPC, Beckhoff IPC C5102-0060, with Rack Cabinet
- Rohde& Schwarz FSL 6, Spectrum Analyzer, Frequency Range: 9 KHz to 6 GHz,28 MHz bandwith
- RAS, Spectracyber 1420 MHz H Line, Spectrometer

### 4. RADIO TELESCOPE CONTROL SOFTWARE

TCS is a digital control system that provides all the commands and displays required for real time operation of an antenna system. TCS is designed to illustrate the information about the current date, Local Time, Julian Date (JD) and local Sidereal Time (LST) of the UZAYBIMER to control the position

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Fig. 2. TCS Algorithm.

and drive the movement of the antenna and track a celestial object. TCS has been developed at Lab-VIEW 2014 (x64) and it runs on Windows 10 Pro Operating System.



Fig. 3. The main view of TCS program.

# 5. INDUSTRIAL INFRASTRUCTURE

A real-time Ethernet technology by Beckhoff has flexible topology and simple configuration properties. EtherCAT (Ethernet for control automation technology) has been preferred in the radio telescope control system (http://www.beckhoff.com/english.asp?ethercat/). It is crucially important to have real-time operation, real time data delivery and to store the data to control radio astronomical devices.

#### 6. LABVIEW

LabVIEW, Laboratory Virtual Instrument Engineering Workbench, is a programming environment (http://www.ni.com/labview/). It is developed for people such as engineers and scientists, interactively developing software, analyzing the data, acquiring the measurements and offering the consequences visually. So that you are able to get the results as you want by designing just like a virtual device . Lab-VIEW is effectively used in many engineering and scientific areas such as data acquisition (DAQ), instrument check, embedded monitoring and control systems, composing prototypes, signal processing.

# 7. ASCOM

ASCOM (AStronomy Common Object Model) is an initiative, a group of astronomy software developers and astronomy device manufacturers devoted to vendor-independent plug-and-play control. ASCOM is a many-to-many and language-independent architecture, supported by most astronomy devices which connect to Windows computers (http://ascom-standards.org/).



Fig. 4. 13m dish, inside view.

## 8. FUTURE PLANS

UZAYBİMER is Turkey's first and unique radio astronomy observatory. Our fundemantal work areas are especially the radio astronomy. It will provide research, application and learning opportunities for any professionals, instructors, students and public in the area of radio and optical astronomy. UZAYBİMER has been being developed with a modern infrastructure. As range of the telescope's power which are going to be placed in our observatory, the following subjects will be studied: Sun, Radio Galaxies, Pulsars, ISM.

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