

# PushToSky – EN

## Phone-Based Astronomical Telescope Control, Simplified.

Push to Sky is a **low-cost control system for astronomical telescopes** that utilizes a mobile phone's sensors.

### Key Features

- **Phone-Based Hand Control:** The telescope's current direction can be determined and tracked in real-time using the mobile phone's sensors (gyroscope, accelerometer, compass).
  - **Compatible with Alt-Azimuth Telescopes:** Specifically designed for alt-azimuth mechanical systems, making it easy to use with **Dobsonian, refractor, or beginner non-motorized telescopes**.
  - **Sensor Data Processing with Kalman Filter:** The system filters and smooths out the noisy sensor data from the mobile phone, providing more reliable direction determination for the telescope.
  - **Star Calibration and Correction:** With single-star or multi-point alignment (teaching), the system can correct for sensor errors, allowing for even more precise targeting.
  - **Client-Server Connection:** Phone data is transmitted via Wi-Fi to the computer, where the system displays the current direction, suggests movements, and assists navigation on a virtual sky map shown on the screen.
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## User Manual

### Installation Kit:

- **Phone:**
  - TelescopeMotionSender for Push\_to\_Sky.apk (Sends telescope direction data to the Push\_to\_Sky system)
  - GPS Sender for Push\_to\_Sky.apk (Sends GPS data to the Push\_to\_Sky system)
- **Laptop/Desktop:**
  - Push\_to\_Sky application
  - config.ini file

### How to Use:

1. **Attach the phone to the telescope.**
2. Install the **TelescopeMotionSender for Push\_to\_Sky.apk** and **GPS Sender for Push\_to\_Sky.apk** applications on the phone.
3. Place the **Push\_to\_Sky** application and the **config.ini** file in the same folder on the computer.

4. Start the **Push\_to\_Sky** application, then start the **GPS Sender for Push\_to\_Sky.apk** application on the phone. This transmits your exact location to the system (Remember to **enter the computer's exact IP address**).
  5. **Restart the Push\_to\_Sky** application.
  6. Then, start the **TelescopeMotionSender for Push\_to\_Sky.apk** application on the phone (Again, enter the computer's exact IP address).
  7. Point the telescope, for example, at the star **Antares** and mark it in the single-star alignment.
  8. Now, on the **Tracking** tab, you can select any object (e.g., Deep Sky object/M3), and the system will navigate the telescope to it using the control system.
  9. The phone sensors are not highly accurate, so occasional manual correction may be necessary.
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## Explanation

- **Settings**
  - **Elevation-dependent Azimuth Correction (Degrees):**
- **Push\_to\_Sky 1.0:** Not available.
- **Push\_to\_Sky 1.1:** A common error with phone sensors is that during altitude measurement from 0 to 90 degrees, the Azimuth value also drifts. This function is intended to correct this between 0–90, 90–180, 180–270, and 270–360 degrees.
  - **Usage Example** (in the “Azimuth correction 0-90 degrees” section): Set the telescope to Azimuth 45 degrees and Altitude 0 degrees. In the “Azimuth correction – 0-90 degrees” section, press the “Mark 1” button, then set the telescope to Azimuth 45 degrees and Altitude 90 degrees. To finalize the calibration, press the “Mark 2” button.
- **Push\_to\_Sky 1.2:** A common error with phone sensors is that during altitude measurement from 0 to 90 degrees, the Azimuth value also drifts. This function is intended to correct this between 0–360 degrees.
  - **Usage Example:** Point the telescope at a bright star at approximately 45 degrees altitude and press the “Start Calibration” button. Now rotate the telescope completely around and point it back at the previously targeted star, then press the “Finish Calibration” button.
  - **Control System Sensitivity (Degrees):**
    - The sensitivity of the direction indicator system located on the "Tracking" tab can be adjusted between 0.3 and 1 degree.
  - **Orientation Data (UDP):**
    - Orientation data (Degrees) received from the phone sensor.

- **Tracking**
  - **Target Selection:**
    - Includes a search field and a list of celestial bodies from which you can select the object you wish to observe (Bright Stars, Deep Sky Objects, Solar System).
  - **Calculated Celestial Body Position:**
    - The position of the celestial body selected in the "Target Selection" section.
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  - **Direction Indicator:**
    - Here you can choose whether to use raw or filtered (Kalman filter) data. The latter can be helpful while moving the telescope. Arrows assist in moving the telescope, and a green dot indicates that the target has been acquired.
  - **Multi-point Alignment (Teaching):**
    - You can select multiple objects from the "Target Selection" section for alignment purposes. Point the telescope at a selected object, then mark it with the "**Mark for Calibration**" button and repeat this process for any additional objects. After marking 1, 2, 3, or even 4 objects, click the "**Perform Calibration**" button. During the day, the PushToSky system can even be aligned by marking the Moon once.
  - **Current Position and Offset:**
    - Indicates the telescope's current direction and allows for manual correction or offset.
  - **Virtual Sky Map (Available: Push\_to\_Sky 1.0, Push\_to\_Sky 1.1):**
    - Pressing the button opens a virtual sky map that can help with orientation in the sky.
- **Single-star Alignment**
  - Point the telescope, for example, at the **Polaris** star. Mark Polaris from the list, then press the "**Mark and Correct**" button. After this, you can select a target object in the "**Target Selection**" section on the "**Tracking**" tab.
- **Stellarium (Available from 1.2)**
  - Control Stellarium Desktop software via API.

**About the Project**

The goal of Push to Sky is to make precise telescope control accessible to everyone using simple tools.

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