

moon phase calculator nasa

moon phase calculator nasa has become an essential tool for astronomers, educators, photographers, and anyone fascinated by the celestial dance of our lunar companion. With NASA's reputation for pioneering space exploration and scientific precision, their moon phase calculator offers a reliable resource for understanding the moon's current phase, predicting future lunar cycles, and planning activities aligned with lunar cycles. Whether you're interested in tracking the full moon for photography, planning a lunar eclipse viewing, or simply curious about the moon's current appearance, NASA's moon phase calculator provides accurate data supported by cutting-edge astronomical research.

Understanding the Importance of a Moon Phase Calculator NASA

What Is a Moon Phase Calculator?

A moon phase calculator is a tool that determines the current phase of the moon based on specific date and time inputs. It calculates the moon's position relative to Earth and the Sun, providing details such as new moon, waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, last quarter, and waning crescent.

Why Use NASA's Moon Phase Calculator?

NASA's moon phase calculator stands out because of its scientific accuracy, data reliability, and comprehensive lunar information. It incorporates precise lunar orbit calculations, accounting for gravitational influences, elliptical orbit variations, and historical data, ensuring that users receive the

most accurate lunar phase information available.

Features of NASA's Moon Phase Calculator

Accurate Lunar Phase Predictions

NASA's lunar calculations are based on extensive astronomical data and sophisticated models. This ensures that the moon phase predictions are highly precise, which is essential for scientific research, event planning, and personal curiosity.

Historical and Future Data

The calculator provides not only current lunar phases but also historical data and future predictions. Users can explore past lunar phases or plan for upcoming full moons, new moons, or lunar eclipses.

Integration with NASA's Data Systems

NASA's moon phase calculator seamlessly integrates with other space and astronomical data systems. This integration allows for detailed lunar information, such as moonrise and moonset times, illumination percentage, and the dates of upcoming lunar events.

User-Friendly Interface

Designed with accessibility in mind, NASA's calculator features an intuitive interface that allows users to input dates easily and receive clear, detailed results. It is suitable for both amateur stargazers and professional astronomers.

How to Use the NASA Moon Phase Calculator

Step-by-Step Guide

1. Visit NASA's official moon phase calculator webpage.
2. Enter the specific date for which you want to know the lunar phase. This can be today's date or a future/past date.
3. Optional: Adjust location settings if you want to see moonrise, moonset times, or illumination data specific to your geographical area.
4. Click the "Calculate" or equivalent button.
5. Review the results, which typically include the current moon phase, illumination percentage, moonrise/moonset times, and other relevant data.

Understanding the Data Output

- Moon Phase: Indicates the current phase (e.g., full moon, new moon, etc.).
- Illumination: Shows the percentage of the moon illuminated.
- Moonrise and Moonset: Times when the moon appears and disappears from view at your location.
- Next Lunar Event: Dates for upcoming full moons, new moons, or lunar eclipses.

Benefits of Using NASA's Moon Phase Calculator

Scientific Accuracy

As a leading space agency, NASA employs the most advanced astronomical models and data, ensuring that their moon phase calculator provides highly accurate information that can be trusted for scientific research or educational purposes.

Event Planning

Photographers and event organizers can plan their activities around specific lunar phases. For example, capturing a full moon or observing a lunar eclipse requires precise timing, which NASA's calculator facilitates.

Educational Use

Teachers and students can utilize NASA's moon phase calculator to enhance lessons about lunar cycles, gravitational influences, and celestial mechanics, making learning more interactive and data-driven.

Personal Curiosity and Hobbyist Astronomy

For amateur astronomers and moon enthusiasts, this tool makes tracking lunar phases straightforward, fostering a deeper appreciation of the moon's changing appearance.

Additional Resources and Tools from NASA

NASA's Lunar Calendars

NASA provides comprehensive lunar calendars that detail full moon, new moon, and eclipse dates for years ahead, supplementing the moon phase calculator for long-term planning.

NASA's Moon Phase Widget

For website owners and educators, NASA offers embeddable widgets that display current moon phases, providing real-time lunar data to visitors.

Educational Content and Articles

NASA's website features in-depth articles on lunar science, explaining phenomena such as supermoons, lunar eclipses, and the science behind moon phases, which can complement the data from the calculator.

How Moon Phases Affect Various Activities

Agriculture and Gardening

Some farmers and gardeners follow lunar cycles to optimize planting and harvesting schedules, believing that certain phases enhance plant growth.

Fishing and Hunting

Many anglers and hunters consider moon phases when planning outings, as the lunar cycle influences animal behavior and fish activity.

Health and Wellness

Some individuals observe lunar phases for personal or spiritual reasons, believing that certain phases impact sleep, mood, or energy levels.

Event Planning and Photography

Photographers often plan shoots around full moons or new moons to achieve specific lighting conditions or atmospheric effects.

Frequently Asked Questions about NASA's Moon Phase Calculator

Is NASA's moon phase calculator free to use?

Yes, NASA provides its moon phase calculator as a free online resource accessible to the public.

Can I use NASA's calculator for professional astronomical research?

Absolutely. NASA's data is highly accurate and suitable for professional research, educational projects, and detailed lunar studies.

Does the calculator account for different time zones?

Yes, the calculator can be adjusted to reflect your local time zone, providing accurate moonrise, moonset, and phase data based on your location.

Can I predict lunar events like eclipses using this tool?

While primarily focused on lunar phases, NASA's tools and calendars also include information about upcoming lunar eclipses and other celestial events.

Conclusion

The moon phase calculator **NASA** stands as a cornerstone resource for anyone interested in lunar phenomena. Its scientific accuracy, comprehensive data, and user-friendly interface make it invaluable for a wide range of users—from casual skywatchers to professional astronomers. By leveraging NASA's advanced astronomical models, users can stay informed about the moon's current phase, plan for upcoming lunar events, and deepen their understanding of our natural satellite's rhythmic cycle. Whether for educational purposes, event planning, or personal curiosity, NASA's moon phase calculator offers a reliable and insightful window into the lunar calendar, helping us appreciate the celestial beauty and scientific complexity of the moon.

Frequently Asked Questions

What is a moon phase calculator provided by NASA?

A moon phase calculator by NASA is an online tool that determines the current or future moon phases based on date and location, utilizing NASA's accurate lunar data.

How accurate is NASA's moon phase calculator?

NASA's moon phase calculator is highly accurate, as it uses precise lunar data and algorithms developed from NASA's space missions and observations, ensuring reliable moon phase predictions.

Can I use NASA's moon phase calculator to plan astronomical observations?

Yes, NASA's moon phase calculator can help astronomers and enthusiasts plan observations by providing detailed moon phase information, including full moon, new moon, and other phases.

Is NASA's moon phase calculator available for mobile devices?

Yes, NASA's moon phase calculator is accessible via web browsers on mobile devices, making it convenient to check moon phases on the go.

How does NASA's moon phase calculator differ from other online tools?

NASA's moon phase calculator is distinguished by its scientific accuracy, based on NASA's lunar data, whereas some other tools may use simplified or less precise algorithms.

Where can I access NASA's moon phase calculator?

You can access NASA's moon phase calculator through official NASA websites, such as the NASA's Lunar Reconnaissance Orbiter site or dedicated lunar phase tools available online.

Additional Resources

Unlocking the Cosmos: A Comprehensive Guide to the Moon Phase Calculator NASA

The moon phase calculator NASA is an essential tool for astronomers, educators, photographers, and

enthusiasts eager to understand the lunar cycle with precision. NASA's moon phase calculator offers a detailed, scientifically accurate way to determine the current phase of the moon, forecast future lunar phases, and understand the celestial mechanics that govern our satellite's behavior. As the moon's phases influence tides, wildlife, and even human activities, having an accurate moon phase calculator is invaluable for both practical and educational purposes.

In this guide, we will explore the inner workings of NASA's moon phase calculator, how it derives lunar phases, practical applications, and tips for making the most of this scientific resource.

Understanding the Basics: What Are Moon Phases?

Before diving into the specifics of the moon phase calculator, it's crucial to understand what moon phases are and why they occur.

The Lunar Cycle

The lunar cycle is the period it takes for the moon to complete a full orbit around Earth, approximately 29.53 days. This cycle produces the various moon phases, which are:

- New Moon
- Waxing Crescent
- First Quarter
- Waxing Gibbous
- Full Moon
- Waning Gibbous
- Last Quarter
- Waning Crescent

Each phase reflects the moon's relative position to the Earth and Sun, influencing how much of the

moon's surface is illuminated and visible from Earth.

Why Do Moon Phases Change?

The changing phases occur because of the relative positions of the Sun, Earth, and Moon. As the moon orbits Earth, different portions of its surface are illuminated by the Sun, resulting in the various phases visible from our vantage point.

The Science Behind NASA's Moon Phase Calculator

NASA's moon phase calculator is grounded in precise astronomical data and complex algorithms. It uses the moon's current position in its orbit, accounting for variations such as elliptical orbit and libration, to determine the lunar phase at any given date.

How Does the Calculator Work?

The core principle behind NASA's calculator involves calculating the moon's phase angle, which is the angular distance between the Sun and the Moon as observed from Earth. The phase angle helps determine the percentage of the moon illuminated and its current phase.

Key components include:

- Ephemerides Data: NASA utilizes highly accurate ephemerides—tables that provide the positions of celestial bodies at specific times—such as the Jet Propulsion Laboratory's Development Ephemeris (JPL DE) series.
- Lunar Position Calculations: Using algorithms like the simplified versions of the lunar theory, the calculator determines the moon's position relative to Earth and the Sun.
- Illumination Calculation: Based on the moon's position, it computes the illuminated fraction of the lunar surface.

- Phase Determination: From the illumination and phase angle, it concludes the current lunar phase.

Scientific Accuracy

Thanks to NASA's access to cutting-edge data and computational methods, the moon phase calculator provides predictions with high precision—accurate to within a few hours or minutes. This level of accuracy is essential for applications like astronomical research, planning lunar observations, or coordinating space missions.

How to Use NASA's Moon Phase Calculator

Using NASA's moon phase calculator is straightforward but requires understanding some key inputs and outputs.

Step 1: Access the Tool

NASA offers several online moon phase calculators, often accessible through their official websites or through tools like the JPL Solar System Dynamics Group. Some popular options include:

- [NASA's Moon Phase and Libration Data](<https://moon.nasa.gov/resources/298/moon-phase-and-libration-data/>)
- [JPL Solar System Dynamics Group's Ephemerides](<https://ssd.jpl.nasa.gov/horizons.cgi>)

Step 2: Input the Date

You can select a specific date—past, present, or future—to find the moon phase for that day. The calculator typically offers options for:

- Entering a specific calendar date

- Selecting a date range for lunar phase predictions

Step 3: View the Results

The calculator will output:

- The current moon phase (e.g., waxing crescent, full moon)
- The percentage of illumination
- The moon's age in days
- The moon's ecliptic longitude
- Additional data like rise/set times, libration, and elongation

Step 4: Interpret the Data

Understanding the results allows you to:

- Plan astronomical observations or photography sessions
- Schedule outdoor activities affected by lunar illumination
- Educate students about lunar cycles

Practical Applications of the Moon Phase Calculator NASA

The precision and reliability of NASA's moon phase calculator make it a versatile tool across various domains.

1. Astronomical Observations and Research

Professional and amateur astronomers depend on accurate lunar phase data to:

- Schedule observations of faint celestial objects during new moon phases
- Study lunar libration and surface features
- Coordinate telescope time around lunar illumination

2. Photography and Filmmaking

Photographers and filmmakers leverage moon phase data to:

- Capture moonlit landscapes during specific phases like full moon or crescent
- Plan night shoots avoiding bright moonlight for astrophotography
- Synchronize outdoor shoots with lunar events

3. Cultural and Religious Events

Many cultural, religious, or traditional festivals are tied to lunar phases. Accurate moon phase information helps communities:

- Mark festivals like Ramadan, Easter, or Chinese New Year
- Plan rituals that depend on specific lunar phases

4. Agricultural and Fishing Activities

Traditional practices often rely on lunar cycles, such as:

- Planting or harvesting crops during certain moon phases
- Timing fishing activities around tides influenced by lunar positions

5. Space Missions and Satellite Operations

NASA and other space agencies utilize lunar phase data for:

- Planning lunar landings and rover missions
- Coordinating satellite orbits and observations

Tips for Maximizing the Use of NASA's Moon Phase Calculator

- Cross-reference data: Use multiple sources to verify lunar phase predictions for critical planning.
- Understand lunar terminology: Familiarity with terms like "libration" and "phase angle" enhances interpretation.
- Leverage visualization tools: Many calculators provide graphical representations of the moon's appearance, aiding in planning.
- Plan ahead: For events like eclipses or lunar eclipses, use the calculator well in advance to prepare logistics.
- Use mobile apps: NASA's moon phase data is often integrated into astronomy apps for on-the-go planning.

Limitations and Considerations

While NASA's moon phase calculator is highly accurate, users should be aware of certain limitations:

- Time Zone Differences: Ensure that the date and time are correctly converted to your local time zone.
- Libration and Illumination Variations: Slight variations can occur due to libration (wobbling of the moon), which might affect visibility.
- Weather Conditions: Cloud cover and atmospheric conditions can influence actual observation despite accurate predictions.

Conclusion: Embracing the Lunar Cycle with NASA's Precision Tools

Understanding the lunar cycle is not just a matter of curiosity but a gateway to appreciating the intricate dance between Earth and its natural satellite. The moon phase calculator NASA exemplifies the pinnacle of astronomical precision, providing users with reliable data rooted in decades of scientific research. By mastering its use, enthusiasts can deepen their appreciation of lunar phenomena, enhance their observational endeavors, and connect more profoundly with the celestial rhythms that have guided humanity for millennia.

Whether you're a professional astronomer planning a lunar eclipse observation, a photographer capturing the glow of the full moon, or a teacher preparing an educational lesson on lunar phases, NASA's moon phase calculator is an indispensable resource—bridging the gap between complex science and everyday curiosity about our nearest celestial neighbor.

[Moon Phase Calculator Nasa](#)

moon phase calculator nasa: *Astronomy 2e* Andrew Fraknoi, David Morrison, Sidney Wolff, 2024-09-12 Designed to meet the scope and sequence of your course, Astronomy 2e is written in clear non-technical language, with the occasional touch of humor and a wide range of clarifying illustrations. It has many analogies drawn from everyday life to help non-science majors appreciate, on their own terms, what our modern exploration of the universe is revealing. The book can be used for either a one-semester or two-semester introductory course.

moon phase calculator nasa: Lunar Alchemy Shaheen Miro, 2020-08-01 "Lunar Alchemy helps readers tap into the dark to find the gold. Rituals, exercises, and journaling prompts, all delivered in Shaheen's beautiful prose, set the stage for deep exploration and lasting change."—Theresa Reed, author of *Astrology for Real Life* Wherever you are in life, you are experiencing a phase. Just like the moon, you are on a journey from dark to light and back again, treading the path from inward journey to outward expression. And for whatever phase you may be in, there is magic to be discovered—magic that can transform your life. In *Lunar Alchemy*, Shaheen Miro—a much-loved intuitive and energy worker—offers a new way of moving through the world. As you read this book, Miro will teach you how to embrace the moon's progression through the sky. Something in you will be awakened, a strange stirring of magic that has always been there. Each phase of the moon, writes Shaheen, is an invitation to fully participate in your life experience and to ultimately shine your light in full glory. The practices you will find here are available to anyone who is open to the prospect of awakening magic in their life for introspection, radical self-care, and personal empowerment. Shaheen shares here his profound and personal understanding of the moon and the ways in which she can enrich our lives. By aligning yourself with the moon, you ultimately learn your own ebb and flow of lunar energy and take up this path for personal transformation.

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moon phase calculator nasa: Ancestral Tarot Nancy Hendrickson, 2021-03-01 A practical, hands-on guide for using tarot to connect with your ancestors and gain access to their insights for healing, self-protection, and personal powers. With a tarot deck in hand, readers will learn how to identify and access ancestral gifts, messages, powers, protectors, and healers. Tarot expert Nancy Hendrickson guides readers through the basics of finding recent ancestors, and navigating the confusing maze of DNA and ethnic heritage. As a longtime tarot enthusiast, she shows readers how to incorporate a metaphysical tool into a world of tradition. Ancestral Tarot spreads are included in relevant chapters. Each chapter includes three journal prompts that lead readers into self-discovery around ancestral gifts, wounds, and patterns they may have inherited. The better we know our ancestors, the better we know ourselves.

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moon phase calculator nasa: The Battle of Arginusae Debra Hamel, 2015-06-25 Aimed at classics students and general readers, the book provides an in-depth examination of the fraught relationship between Athens' military commanders and its vaunted sovereign democracy.

moon phase calculator nasa: Exploring the Moon , 1994

moon phase calculator nasa: NASA's Planetary Data System , 1992

moon phase calculator nasa: NASA SP. , 1992

moon phase calculator nasa: First Light and Beyond D. A. Jenkins, 2015-07-28 Amateur astronomers who have been disappointed by the results of an observing session can take comfort in the guidance of this book, which advises how to still gain useful experience in seemingly failed nights at the telescope. In a world with imperfect seeing conditions, incredible observing sessions are often mixed with less inspiring ones, discouraging the amateur observer. This book is designed to minimize subsequent disappointment for astronomers who encounter a few bad observing sessions, helping novice observers take something worthwhile away each and every time they go out under the night sky, regardless of the observations that were originally planned. Almost every observer remembers his first sight of ringed Saturn, hanging in the blackness of space. Practitioners agree that there is something special about visual observing. Real-time observations at the eyepiece can provide fleeting yet intense feelings that connect us with the universe in unique ways. But when expectations aren't met at the eyepiece, there are other ways to profit from the practice of astronomy. These rewards, though less showy, are well worth cultivating. This is a book that will help the reader see what constitutes a "successful" visual observing session. It explains the nature of the objects that the observer is seeing and advises how best to use their equipment. There are many hints and tips about how best to locate, recall, and record observations, including suggestions for trips to areas where there are dark skies and to public observatories. Amateur astronomy is a journey from the urban backyard all the way to dark rural skies, and with this guide the journey can be smooth.

moon phase calculator nasa: Share the Universe Richard Stember, 2024-04-01 As every astronomer knows, astronomy is one of the most approachable and inspiring of the natural sciences. It appeals to both children and adults while drawing in curious minds with its immense distances and unimaginably powerful natural phenomena. In this book, you will find out how to be a part of the

journey in sharing scientific knowledge and inspiring minds of all ages. By using the affordable tools and techniques provided in this book – you will learn about how astronomers can easily engage people with views of our solar system’s planets, moons, and even more distant objects like nebulae, stellar nurseries, and remnants of exploded stars. Perhaps most importantly, the natural appeal of this science is helpful when explaining to non-scientists how science “works. What is science and scientific methodology? How is it used to give mankind knowledge and solutions to problems that we face in many scientific fields including medicine? How does it differ from other sources of information? This book, sprinkled with the author’s 24 plus years of personal experience in public outreach, offers practical techniques to engage, educate, and inspire all who are interested in the field of astronomy.

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moon phase calculator nasa: A Man & His Watch Matt Hranek, 2017-10-31 “I’ve paged through stacks of books on the history of watches. . . . But I hadn’t come across a book that actually moved me until I picked up *A Man and His Watch*. The volume is filled with heartfelt stories.” —T: The New York Times Style Magazine There are a bunch of beautifully illustrated watch books out there, but *A Man & His Watch* by Matt Hranek is more than that. It speaks to the nature of watches as deeply personal items. —Gear Patrol, Coffee Table Books Our Staff Can’t Live Without Paul Newman wore his Rolex Daytona every single day for 35 years until his death in 2008. The iconic timepiece, probably the single most sought-after watch in the world, is now in the possession of his daughter Clea, who wears it every day in his memory. Franklin Roosevelt wore an elegant gold Tiffany watch, gifted to him by a friend on his birthday, to the famous Yalta Conference where he shook the hands of Joseph Stalin and Winston Churchill. JFK’s Omega worn to his presidential inauguration, Ralph Lauren’s watch purchased from Andy Warhol’s personal collection, Sir Edmund Hillary’s Rolex worn during the first-ever summit of Mt. Everest . . . these and many more compose the stories of the world’s most coveted watches captured in *A Man and His Watch*. Matthew Hranek, a watch collector and NYC men’s style fixture, has traveled the world conducting firsthand interviews and diving into exclusive collections to gather the never-before-told stories of 76 watches, completed with stunning original photography of every single piece. Through these intimate accounts and Hranek’s storytelling, the watches become more than just timepieces and status symbols; they represent historical moments, pioneering achievements, heirlooms, family mementos, gifts of affection, and lifelong friendships.

moon phase calculator nasa: Automatic Solar Tracking Sun Tracking Satellite Tracking rastreador solar seguimiento solar seguidor solar automático de seguimiento solar Gerro Prinsloo, Robert Dobson, 2015-11-01 Automatic Solar Tracking Sun Tracking : This book details Automatic Solar-Tracking, Sun-Tracking-Systems, Solar-Trackers and Sun Tracker Systems. An intelligent automatic solar tracker is a device that orients a payload toward the sun. Such programmable computer based solar tracking device includes principles of solar tracking, solar tracking systems, as well as microcontroller, microprocessor and/or PC based solar tracking control to orientate solar reflectors, solar lenses, photovoltaic panels or other optical configurations towards the sun. Motorized space frames and kinematic systems ensure motion dynamics and employ drive technology and gearing principles to steer optical configurations such as mangin, parabolic, conic, or cassegrain solar energy collectors to face the sun and follow the sun movement contour continuously (seguimiento solar y automatización, automatización seguidor solar, tracking solar e automação, automação seguidor solar, inseguimento solare, inseguitore solare, energia termica, sole seguito, posizionatore motorizzato) In harnessing power from the sun through a solar tracker or practical solar tracking system, renewable energy control automation systems require automatic solar tracking software and solar position algorithms to accomplish dynamic motion control with control automation architecture, circuit boards and hardware. On-axis sun tracking system such as the altitude-azimuth dual axis or multi-axis solar tracker systems use a sun tracking algorithm or ray

tracing sensors or software to ensure the sun's passage through the sky is traced with high precision in automated solar tracker applications, right through summer solstice, solar equinox and winter solstice. A high precision sun position calculator or sun position algorithm is this an important step in the design and construction of an automatic solar tracking system. The content of the book is also applicable to communication antenna satellite tracking and moon tracking algorithm source code for which links to free download links are provided. From sun tracing software perspective, the sonnet Tracing The Sun has a literal meaning. Within the context of sun track and trace, this book explains that the sun's daily path across the sky is directed by relatively simple principles, and if grasped/understood, then it is relatively easy to trace the sun with sun following software. Sun position computer software for tracing the sun are available as open source code, sources that is listed in this book. The book also describes the use of satellite tracking software and mechanisms in solar tracking applications. Ironically there was even a system called sun chaser, said to have been a solar positioner system known for chasing the sun throughout the day. Using solar equations in an electronic circuit for automatic solar tracking is quite simple, even if you are a novice, but mathematical solar equations are over complicated by academic experts and professors in text-books, journal articles and internet websites. In terms of solar hobbies, scholars, students and Hobbyist's looking at solar tracking electronics or PC programs for solar tracking are usually overcome by the sheer volume of scientific material and internet resources, which leaves many developers in frustration when search for simple experimental solar tracking source-code for their on-axis sun-tracking systems. This booklet will simplify the search for the mystical sun tracking formulas for your sun tracker innovation and help you develop your own autonomous solar tracking controller. By directing the solar collector directly into the sun, a solar harvesting means or device can harness sunlight or thermal heat. This is achieved with the help of sun angle formulas, solar angle formulas or solar tracking procedures for the calculation of sun's position in the sky. Automatic sun tracking system software includes algorithms for solar altitude azimuth angle calculations required in following the sun across the sky. In using the longitude, latitude GPS coordinates of the solar tracker location, these sun tracking software tools supports precision solar tracking by determining the solar altitude-azimuth coordinates for the sun trajectory in altitude-azimuth tracking at the tracker location, using certain sun angle formulas in sun vector calculations. Instead of follow the sun software, a sun tracking sensor such as a sun sensor or webcam or video camera with vision based sun following image processing software can also be used to determine the position of the sun optically. Such optical feedback devices are often used in solar panel tracking systems and dish tracking systems. Dynamic sun tracing is also used in solar surveying, DNI analyser and sun surveying systems that build solar infographics maps with solar radiance, irradiance and DNI models for GIS (geographical information system). In this way geospatial methods on solar/environment interaction makes use use of geospatial technologies (GIS, Remote Sensing, and Cartography). Climatic data and weather station or weather center data, as well as queries from sky servers and solar resource database systems (i.e. on DB2, Sybase, Oracle, SQL, MySQL) may also be associated with solar GIS maps. In such solar resource modelling systems, a pyranometer or solarimeter is normally used in addition to measure direct and indirect, scattered, dispersed, reflective radiation for a particular geographical location. Sunlight analysis is important in flash photography where photographic lighting are important for photographers. GIS systems are used by architects who add sun shadow applets to study architectural shading or sun shadow analysis, solar flux calculations, optical modelling or to perform weather modelling. Such systems often employ a computer operated telescope type mechanism with ray tracing program software as a solar navigator or sun tracer that determines the solar position and intensity. The purpose of this booklet is to assist developers to track and trace suitable source-code and solar tracking algorithms for their application, whether a hobbyist, scientist, technician or engineer. Many open-source sun following and tracking algorithms and source-code for solar tracking programs and modules are freely available to download on the internet today. Certain proprietary solar tracker kits and solar tracking controllers include a software development kit SDK for its application programming

interface API attributes (Pebble). Widget libraries, widget toolkits, GUI toolkit and UX libraries with graphical control elements are also available to construct the graphical user interface (GUI) for your solar tracking or solar power monitoring program. The solar library used by solar position calculators, solar simulation software and solar contour calculators include machine program code for the solar hardware controller which are software programmed into Micro-controllers, Programmable Logic Controllers PLC, programmable gate arrays, Arduino processor or PIC processor. PC based solar tracking is also high in demand using C++, Visual Basic VB, as well as MS Windows, Linux and Apple Mac based operating systems for sun path tables on Matlab, Excel. Some books and internet webpages use other terms, such as: sun angle calculator, sun position calculator or solar angle calculator. As said, such software code calculate the solar azimuth angle, solar altitude angle, solar elevation angle or the solar Zenith angle (Zenith solar angle is simply referenced from vertical plane, the mirror of the elevation angle measured from the horizontal or ground plane level). Similar software code is also used in solar calculator apps or the solar power calculator apps for IOS and Android smartphone devices. Most of these smartphone solar mobile apps show the sun path and sun-angles for any location and date over a 24 hour period. Some smartphones include augmented reality features in which you can physically see and look at the solar path through your cell phone camera or mobile phone camera at your phone's specific GPS location. In the computer programming and digital signal processing (DSP) environment, (free/open source) program code are available for VB, .Net, Delphi, Python, C, C+, C++, PHP, Swift, ADM, F, Flash, Basic, QBasic, GBasic, KBasic, SIMPL language, Squirrel, Solaris, Assembly language on operating systems such as MS Windows, Apple Mac, DOS or Linux OS. Software algorithms predicting position of the sun in the sky are commonly available as graphical programming platforms such as Matlab (Mathworks), Simulink models, Java applets, TRNSYS simulations, Scada system apps, Labview module, Beckhoff TwinCAT (Visual Studio), Siemens SPA, mobile and iphone apps, Android or iOS tablet apps, and so forth. At the same time, PLC software code for a range of sun tracking automation technology can follow the profile of sun in sky for Siemens, HP, Panasonic, ABB, Allan Bradley, OMRON, SEW, Festo, Beckhoff, Rockwell, Schneider, Endress Hauser, Fudji electric. Honeywell, Fuchs, Yokonawa, or Muthibishi platforms. Sun path projection software are also available for a range of modular IPC embedded PC motherboards, Industrial PC, PLC (Programmable Logic Controller) and PAC (Programmable Automation Controller) such as the Siemens S7-1200 or Siemens Logo, Beckhoff IPC or CX series, OMRON PLC, Ercam PLC, AC500plc ABB, National Instruments NI PXI or NI cRIO, PIC processor, Intel 8051/8085, IBM (Cell, Power, Brain or Truenorth series), FPGA (Xilinx Altera Nios), Intel, Xeon, Atmel megaAVR, MPU, Maple, Teensy, MSP, XMOS, Xbee, ARM, Raspberry Pi, Eagle, Arduino or Arduino AtMega microcontroller, with servo motor, stepper motor, direct current DC pulse width modulation PWM (current driver) or alternating current AC SPS or IPC variable frequency drives VFD motor drives (also termed adjustable-frequency drive, variable-speed drive, AC drive, micro drive or inverter drive) for electrical, mechatronic, pneumatic, or hydraulic solar tracking actuators. The above motion control and robot control systems include analogue or digital interfacing ports on the processors to allow for tracker angle orientation feedback control through one or a combination of angle sensor or angle encoder, shaft encoder, precision encoder, optical encoder, magnetic encoder, direction encoder, rotational encoder, chip encoder, tilt sensor, inclination sensor, or pitch sensor. Note that the tracker's elevation or zenith axis angle may measured using an altitude angle-, declination angle-, inclination angle-, pitch angle-, or vertical angle-, zenith angle- sensor or inclinometer. Similarly the tracker's azimuth axis angle be measured with a azimuth angle-, horizontal angle-, or roll angle-sensor. Chip integrated accelerometer magnetometer gyroscope type angle sensors can also be used to calculate displacement. Other options include the use of thermal imaging systems such as a Fluke thermal imager, or robotic or vision based solar tracker systems that employ face tracking, head tracking, hand tracking, eye tracking and car tracking principles in solar tracking. With unattended decentralised rural, island, isolated, or autonomous off-grid power installations, remote control, monitoring, data acquisition, digital datalogging and online measurement and verification equipment

becomes crucial. It assists the operator with supervisory control to monitor the efficiency of remote renewable energy resources and systems and provide valuable web-based feedback in terms of CO₂ and clean development mechanism (CDM) reporting. A power quality analyser for diagnostics through internet, WiFi and cellular mobile links is most valuable in frontline troubleshooting and predictive maintenance, where quick diagnostic analysis is required to detect and prevent power quality issues. Solar tracker applications cover a wide spectrum of solar applications and solar assisted application, including concentrated solar power generation, solar desalination, solar water purification, solar steam generation, solar electricity generation, solar industrial process heat, solar thermal heat storage, solar food dryers, solar water pumping, hydrogen production from methane or producing hydrogen and oxygen from water (HHO) through electrolysis. Many patented or non-patented solar apparatus include tracking in solar apparatus for solar electric generator, solar desalinator, solar steam engine, solar ice maker, solar water purifier, solar cooling, solar refrigeration, USB solar charger, solar phone charging, portable solar charging tracker, solar coffee brewing, solar cooking or solar drying means. Your project may be the next breakthrough or patent, but your invention is held back by frustration in search for the sun tracker you require for your solar powered appliance, solar generator, solar tracker robot, solar freezer, solar cooker, solar drier, solar pump, solar freezer, or solar dryer project. Whether your solar electronic circuit diagram include a simplified solar controller design in a solar electricity project, solar power kit, solar hobby kit, solar steam generator, solar hot water system, solar ice maker, solar desalinator, hobbyist solar panels, hobby robot, or if you are developing professional or hobby electronics for a solar utility or micro scale solar powerplant for your own solar farm or solar farming, this publication may help accelerate the development of your solar tracking innovation. Lately, solar polygeneration, solar trigeneration (solar triple generation), and solar quad generation (adding delivery of steam, liquid/gaseous fuel, or capture food-grade CO₂) systems have need for automatic solar tracking. These systems are known for significant efficiency increases in energy yield as a result of the integration and re-use of waste or residual heat and are suitable for compact packaged micro solar powerplants that could be manufactured and transported in kit-form and operate on a plug-and play basis. Typical hybrid solar power systems include compact or packaged solar micro combined heat and power (CHP or mCHP) or solar micro combined, cooling, heating and power (CCHP, CHPC, mCCHP, or mCHPC) systems used in distributed power generation. These systems are often combined in concentrated solar CSP and CPV smart microgrid configurations for off-grid rural, island or isolated microgrid, minigrid and distributed power renewable energy systems. Solar tracking algorithms are also used in modelling of trigeneration systems using Matlab Simulink (Modelica or TRNSYS) platform as well as in automation and control of renewable energy systems through intelligent parsing, multi-objective, adaptive learning control and control optimization strategies. Solar tracking algorithms also find application in developing solar models for country or location specific solar studies, for example in terms of measuring or analysis of the fluctuations of the solar radiation (i.e. direct and diffuse radiation) in a particular area. Solar DNI, solar irradiance and atmospheric information and models can thus be integrated into a solar map, solar atlas or geographical information systems (GIS). Such models allows for defining local parameters for specific regions that may be valuable in terms of the evaluation of different solar in photovoltaic or CSP systems on simulation and synthesis platforms such as Matlab and Simulink or in linear or multi-objective optimization algorithm platforms such as COMPOSE, EnergyPLAN or DER-CAM. A dual-axis solar tracker and single-axis solar tracker may use a sun tracker program or sun tracker algorithm to position a solar dish, solar panel array, heliostat array, PV panel, solar antenna or infrared solar antenna. A self-tracking solar concentrator performs automatic solar tracking by computing the solar vector. Solar position algorithms (TwinCAT, SPA, or PSA Algorithms) use an astronomical algorithm to calculate the position of the sun. It uses astronomical software algorithms and equations for solar tracking in the calculation of sun's position in the sky for each location on the earth at any time of day. Like an optical solar telescope, the solar position algorithm pin-points the solar reflector at the sun and locks onto the sun's position to track the sun across the sky as the sun progresses throughout the day.

Optical sensors such as photodiodes, light-dependant-resistors (LDR) or photoresistors are used as optical accuracy feedback devices. Lately we also included a section in the book (with links to microprocessor code) on how the PixArt Wii infrared camera in the Wii remote or Wiimote may be used in infrared solar tracking applications. In order to harvest free energy from the sun, some automatic solar positioning systems use an optical means to direct the solar tracking device. These solar tracking strategies use optical tracking techniques, such as a sun sensor means, to direct sun rays onto a silicon or CMOS substrate to determine the X and Y coordinates of the sun's position. In a solar mems sun-sensor device, incident sunlight enters the sun sensor through a small pin-hole in a mask plate where light is exposed to a silicon substrate. In a web-camera or camera image processing sun tracking and sun following means, object tracking software performs multi object tracking or moving object tracking methods. In an solar object tracking technique, image processing software performs mathematical processing to box the outline of the apparent solar disc or sun blob within the captured image frame, while sun-localization is performed with an edge detection algorithm to determine the solar vector coordinates. An automated positioning system help maximize the yields of solar power plants through solar tracking control to harness sun's energy. In such renewable energy systems, the solar panel positioning system uses a sun tracking techniques and a solar angle calculator in positioning PV panels in photovoltaic systems and concentrated photovoltaic CPV systems. Automatic on-axis solar tracking in a PV solar tracking system can be dual-axis sun tracking or single-axis sun solar tracking. It is known that a motorized positioning system in a photovoltaic panel tracker increase energy yield and ensures increased power output, even in a single axis solar tracking configuration. Other applications such as robotic solar tracker or robotic solar tracking system uses robotica with artificial intelligence in the control optimization of energy yield in solar harvesting through a robotic tracking system. Automatic positioning systems in solar tracking designs are also used in other free energy generators, such as concentrated solar thermal power CSP and dish Stirling systems. The sun tracking device in a solar collector in a solar concentrator or solar collector Such a performs on-axis solar tracking, a dual axis solar tracker assists to harness energy from the sun through an optical solar collector, which can be a parabolic mirror, parabolic reflector, Fresnel lens or mirror array/matrix. A parabolic dish or reflector is dynamically steered using a transmission system or solar tracking slew drive mean. In steering the dish to face the sun, the power dish actuator and actuation means in a parabolic dish system optically focusses the sun's energy on the focal point of a parabolic dish or solar concentrating means. A Stirling engine, solar heat pipe, thermosyphin, solar phase change material PCM receiver, or a fibre optic sunlight receiver means is located at the focal point of the solar concentrator. The dish Stirling engine configuration is referred to as a dish Stirling system or Stirling power generation system. Hybrid solar power systems (used in combination with biogas, biofuel, petrol, ethanol, diesel, natural gas or PNG) use a combination of power sources to harness and store solar energy in a storage medium. Any multitude of energy sources can be combined through the use of controllers and the energy stored in batteries, phase change material, thermal heat storage, and in cogeneration form converted to the required power using thermodynamic cycles (organic Rankin, Brayton cycle, micro turbine, Stirling) with an inverter and charge controller.

moon phase calculator nasa: Marketing the Moon David Meerman Scott, Richard Jurek, 2014-02-28 One of the most successful public relations campaigns in history, featuring heroic astronauts, press-savvy rocket scientists, enthusiastic reporters, deep-pocketed defense contractors, and Tang. In July 1969, ninety-four percent of American televisions were tuned to coverage of Apollo 11's mission to the moon. How did space exploration, once the purview of rocket scientists, reach a larger audience than My Three Sons? Why did a government program whose standard operating procedure had been secrecy turn its greatest achievement into a communal experience? In *Marketing the Moon*, David Meerman Scott and Richard Jurek tell the story of one of the most successful marketing and public relations campaigns in history: the selling of the Apollo program. Primed by science fiction, magazine articles, and appearances by Wernher von Braun on the "Tomorrowland" segments of the Disneyland prime time television show, Americans were a

receptive audience for NASA's pioneering "brand journalism." Scott and Jurek describe sophisticated efforts by NASA and its many contractors to market the facts about space travel—through press releases, bylined articles, lavishly detailed background materials, and fully produced radio and television features—rather than push an agenda. American astronauts, who signed exclusive agreements with Life magazine, became the heroic and patriotic faces of the program. And there was some judicious product placement: Hasselblad was the "first camera on the moon"; Sony cassette recorders and supplies of Tang were on board the capsule; and astronauts were equipped with the Exer-Genie personal exerciser. Everyone wanted a place on the bandwagon. Generously illustrated with vintage photographs, artwork, and advertisements, many never published before, *Marketing the Moon* shows that when Neil Armstrong took that giant leap for mankind, it was a triumph not just for American engineering and rocketry but for American marketing and public relations.

moon phase calculator nasa: Practical Solar Tracking Automatic Solar Tracking Sun Tracking Автоматическое удержание Солнечная слежения ВС Gerro Prinsloo, Robert Dobson, 2015-11-01 This book details Practical Solar Energy Harvesting, Automatic Solar-Tracking, Sun-Tracking-Systems, Solar-Trackers and Sun Tracker Systems using motorized automatic positioning concepts and control principles. An intelligent automatic solar tracker is a device that orients a payload toward the sun. Such programmable computer based solar tracking device includes principles of solar tracking, solar tracking systems, as well as microcontroller, microprocessor and/or PC based solar tracking control to orientate solar reflectors, solar lenses, photovoltaic panels or other optical configurations towards the sun. Motorized space frames and kinematic systems ensure motion dynamics and employ drive technology and gearing principles to steer optical configurations such as mangin, parabolic, conic, or cassegrain solar energy collectors to face the sun and follow the sun movement contour continuously. In general, the book may benefit solar research and solar energy applications in countries such as Africa, Mediterranean, Italy, Spain, Greece, USA, Mexico, South America, Brazilia, Argentina, Chili, India, Malaysia, Middle East, UAE, Russia, Japan and China. This book on practical automatic Solar-Tracking Sun-Tracking is in .PDF format and can easily be converted to the .EPUB .MOBI .AZW .ePub .FB2 .LIT .LRF .MOBI .PDB .PDF .TCR formats for smartphones and Kindle by using the ebook.online-convert.com facility. The content of the book is also applicable to communication antenna satellite tracking and moon tracking algorithm source code for which links to free download links are provided. In harnessing power from the sun through a solar tracker or practical solar tracking system, renewable energy control automation systems require automatic solar tracking software and solar position algorithms to accomplish dynamic motion control with control automation architecture, circuit boards and hardware. On-axis sun tracking system such as the altitude-azimuth dual axis or multi-axis solar tracker systems use a sun tracking algorithm or ray tracing sensors or software to ensure the sun's passage through the sky is traced with high precision in automated solar tracker applications, right through summer solstice, solar equinox and winter solstice. A high precision sun position calculator or sun position algorithm is this an important step in the design and construction of an automatic solar tracking system. From sun tracing software perspective, the sonnet Tracing The Sun has a literal meaning. Within the context of sun track and trace, this book explains that the sun's daily path across the sky is directed by relatively simple principles, and if grasped/understood, then it is relatively easy to trace the sun with sun following software. Sun position computer software for tracing the sun are available as open source code, sources that is listed in this book. Ironically there was even a system called sun chaser, said to have been a solar positioner system known for chasing the sun throughout the day. Using solar equations in an electronic circuit for automatic solar tracking is quite simple, even if you are a novice, but mathematical solar equations are over complicated by academic experts and professors in text-books, journal articles and internet websites. In terms of solar hobbies, scholars, students and Hobbyist's looking at solar tracking electronics or PC programs for solar tracking are usually overcome by the sheer volume of scientific material and internet resources, which leaves many developers in frustration when search for simple

experimental solar tracking source-code for their on-axis sun-tracking systems. This booklet will simplify the search for the mystical sun tracking formulas for your sun tracker innovation and help you develop your own autonomous solar tracking controller. By directing the solar collector directly into the sun, a solar harvesting means or device can harness sunlight or thermal heat. This is achieved with the help of sun angle formulas, solar angle formulas or solar tracking procedures for the calculation of sun's position in the sky. Automatic sun tracking system software includes algorithms for solar altitude azimuth angle calculations required in following the sun across the sky. In using the longitude, latitude GPS coordinates of the solar tracker location, these sun tracking software tools supports precision solar tracking by determining the solar altitude-azimuth coordinates for the sun trajectory in altitude-azimuth tracking at the tracker location, using certain sun angle formulas in sun vector calculations. Instead of follow the sun software, a sun tracking sensor such as a sun sensor or webcam or video camera with vision based sun following image processing software can also be used to determine the position of the sun optically. Such optical feedback devices are often used in solar panel tracking systems and dish tracking systems. Dynamic sun tracing is also used in solar surveying, DNI analyser and sun surveying systems that build solar infographics maps with solar radiance, irradiance and DNI models for GIS (geographical information system). In this way geospatial methods on solar/environment interaction makes use use of geospatial technologies (GIS, Remote Sensing, and Cartography). Climatic data and weather station or weather center data, as well as queries from sky servers and solar resource database systems (i.e. on DB2, Sybase, Oracle, SQL, MySQL) may also be associated with solar GIS maps. In such solar resource modelling systems, a pyranometer or solarimeter is normally used in addition to measure direct and indirect, scattered, dispersed, reflective radiation for a particular geographical location. Sunlight analysis is important in flash photography where photographic lighting are important for photographers. GIS systems are used by architects who add sun shadow applets to study architectural shading or sun shadow analysis, solar flux calculations, optical modelling or to perform weather modelling. Such systems often employ a computer operated telescope type mechanism with ray tracing program software as a solar navigator or sun tracer that determines the solar position and intensity. The purpose of this booklet is to assist developers to track and trace suitable source-code and solar tracking algorithms for their application, whether a hobbyist, scientist, technician or engineer. Many open-source sun following and tracking algorithms and source-code for solar tracking programs and modules are freely available to download on the internet today. Certain proprietary solar tracker kits and solar tracking controllers include a software development kit SDK for its application programming interface API attributes (Pebble). Widget libraries, widget toolkits, GUI toolkit and UX libraries with graphical control elements are also available to construct the graphical user interface (GUI) for your solar tracking or solar power monitoring program. The solar library used by solar position calculators, solar simulation software and solar contour calculators include machine program code for the solar hardware controller which are software programmed into Micro-controllers, Programmable Logic Controllers PLC, programmable gate arrays, Arduino processor or PIC processor. PC based solar tracking is also high in demand using C++, Visual Basic VB, as well as MS Windows, Linux and Apple Mac based operating systems for sun path tables on Matlab, Excel. Some books and internet webpages use other terms, such as: sun angle calculator, sun position calculator or solar angle calculator. As said, such software code calculate the solar azimuth angle, solar altitude angle, solar elevation angle or the solar Zenith angle (Zenith solar angle is simply referenced from vertical plane, the mirror of the elevation angle measured from the horizontal or ground plane level). Similar software code is also used in solar calculator apps or the solar power calculator apps for IOS and Android smartphone devices. Most of these smartphone solar mobile apps show the sun path and sun-angles for any location and date over a 24 hour period. Some smartphones include augmented reality features in which you can physically see and look at the solar path through your cell phone camera or mobile phone camera at your phone's specific GPS location. In the computer programming and digital signal processing (DSP) environment, (free/open source) program code are available for VB, .Net, Delphi, Python, C, C+, C++, PHP, Swift, ADM, F,

Flash, Basic, QBasic, GBasic, KBasic, SIMPL language, Squirrel, Solaris, Assembly language on operating systems such as MS Windows, Apple Mac, DOS or Linux OS. Software algorithms predicting position of the sun in the sky are commonly available as graphical programming platforms such as Matlab (Mathworks), Simulink models, Java applets, TRNSYS simulations, Scada system apps, Labview module, Beckhoff TwinCAT (Visual Studio), Siemens SPA, mobile and iphone apps, Android or iOS tablet apps, and so forth. At the same time, PLC software code for a range of sun tracking automation technology can follow the profile of sun in sky for Siemens, HP, Panasonic, ABB, Allan Bradley, OMRON, SEW, Festo, Beckhoff, Rockwell, Schneider, Endress Hauser, Fudji electric. Honeywell, Fuchs, Yokonawa, or Muthibishi platforms. Sun path projection software are also available for a range of modular IPC embedded PC motherboards, Industrial PC, PLC (Programmable Logic Controller) and PAC (Programmable Automation Controller) such as the Siemens S7-1200 or Siemens Logo, Beckhoff IPC or CX series, OMRON PLC, Ercam PLC, AC500plc ABB, National Instruments NI PXI or NI cRIO, PIC processor, Intel 8051/8085, IBM (Cell, Power, Brain or Truenorth series), FPGA (Xilinx Altera Nios), Intel, Xeon, Atmel megaAVR, MPU, Maple, Teensy, MSP, XMOS, Xbee, ARM, Raspberry Pi, Eagle, Arduino or Arduino AtMega microcontroller, with servo motor, stepper motor, direct current DC pulse width modulation PWM (current driver) or alternating current AC SPS or IPC variable frequency drives VFD motor drives (also termed adjustable-frequency drive, variable-speed drive, AC drive, micro drive or inverter drive) for electrical, mechatronic, pneumatic, or hydraulic solar tracking actuators. The above motion control and robot control systems include analogue or digital interfacing ports on the processors to allow for tracker angle orientation feedback control through one or a combination of angle sensor or angle encoder, shaft encoder, precision encoder, optical encoder, magnetic encoder, direction encoder, rotational encoder, chip encoder, tilt sensor, inclination sensor, or pitch sensor. Note that the tracker's elevation or zenith axis angle may measured using an altitude angle-, declination angle-, inclination angle-, pitch angle-, or vertical angle-, zenith angle- sensor or inclinometer. Similarly the tracker's azimuth axis angle be measured with a azimuth angle-, horizontal angle-, or roll angle-sensor. Chip integrated accelerometer magnetometer gyroscope type angle sensors can also be used to calculate displacement. Other options include the use of thermal imaging systems such as a Fluke thermal imager, or robotic or vision based solar tracker systems that employ face tracking, head tracking, hand tracking, eye tracking and car tracking principles in solar tracking. With unattended decentralised rural, island, isolated, or autonomous off-grid power installations, remote control, monitoring, data acquisition, digital datalogging and online measurement and verification equipment becomes crucial. It assists the operator with supervisory control to monitor the efficiency of remote renewable energy resources and systems and provide valuable web-based feedback in terms of CO₂ and clean development mechanism (CDM) reporting. A power quality analyser for diagnostics through internet, WiFi and cellular mobile links is most valuable in frontline troubleshooting and predictive maintenance, where quick diagnostic analysis is required to detect and prevent power quality issues. Solar tracker applications cover a wide spectrum of solar applications and solar assisted application, including concentrated solar power generation, solar desalination, solar water purification, solar steam generation, solar electricity generation, solar industrial process heat, solar thermal heat storage, solar food dryers, solar water pumping, hydrogen production from methane or producing hydrogen and oxygen from water (HHO) through electrolysis. Many patented or non-patented solar apparatus include tracking in solar apparatus for solar electric generator, solar desalinator, solar steam engine, solar ice maker, solar water purifier, solar cooling, solar refrigeration, USB solar charger, solar phone charging, portable solar charging tracker, solar coffee brewing, solar cooking or solar dying means. Your project may be the next breakthrough or patent, but your invention is held back by frustration in search for the sun tracker you require for your solar powered appliance, solar generator, solar tracker robot, solar freezer, solar cooker, solar drier, solar pump, solar freezer, or solar dryer project. Whether your solar electronic circuit diagram include a simplified solar controller design in a solar electricity project, solar power kit, solar hobby kit, solar steam generator, solar hot water system, solar ice maker, solar desalinator, hobbyist solar panels,

hobby robot, or if you are developing professional or hobby electronics for a solar utility or micro scale solar powerplant for your own solar farm or solar farming, this publication may help accelerate the development of your solar tracking innovation. Lately, solar polygeneration, solar trigeneration (solar triple generation), and solar quad generation (adding delivery of steam, liquid/gaseous fuel, or capture food-grade CO₂) systems have need for automatic solar tracking. These systems are known for significant efficiency increases in energy yield as a result of the integration and re-use of waste or residual heat and are suitable for compact packaged micro solar powerplants that could be manufactured and transported in kit-form and operate on a plug-and play basis. Typical hybrid solar power systems include compact or packaged solar micro combined heat and power (CHP or mCHP) or solar micro combined, cooling, heating and power (CCHP, CHPC, mCCHP, or mCHPC) systems used in distributed power generation. These systems are often combined in concentrated solar CSP and CPV smart microgrid configurations for off-grid rural, island or isolated microgrid, minigrid and distributed power renewable energy systems. Solar tracking algorithms are also used in modelling of trigeneration systems using Matlab Simulink (Modelica or TRNSYS) platform as well as in automation and control of renewable energy systems through intelligent parsing, multi-objective, adaptive learning control and control optimization strategies. Solar tracking algorithms also find application in developing solar models for country or location specific solar studies, for example in terms of measuring or analysis of the fluctuations of the solar radiation (i.e. direct and diffuse radiation) in a particular area. Solar DNI, solar irradiance and atmospheric information and models can thus be integrated into a solar map, solar atlas or geographical information systems (GIS). Such models allows for defining local parameters for specific regions that may be valuable in terms of the evaluation of different solar in photovoltaic or CSP systems on simulation and synthesis platforms such as Matlab and Simulink or in linear or multi-objective optimization algorithm platforms such as COMPOSE, EnergyPLAN or DER-CAM. A dual-axis solar tracker and single-axis solar tracker may use a sun tracker program or sun tracker algorithm to position a solar dish, solar panel array, heliostat array, PV panel, solar antenna or infrared solar nantenna. A self-tracking solar concentrator performs automatic solar tracking by computing the solar vector. Solar position algorithms (TwinCAT, SPA, or PSA Algorithms) use an astronomical algorithm to calculate the position of the sun. It uses astronomical software algorithms and equations for solar tracking in the calculation of sun's position in the sky for each location on the earth at any time of day. Like an optical solar telescope, the solar position algorithm pin-points the solar reflector at the sun and locks onto the sun's position to track the sun across the sky as the sun progresses throughout the day. Optical sensors such as photodiodes, light-dependant-resistors (LDR) or photoresistors are used as optical accuracy feedback devices. Lately we also included a section in the book (with links to microprocessor code) on how the PixArt Wii infrared camera in the Wii remote or Wiimote may be used in infrared solar tracking applications. In order to harvest free energy from the sun, some automatic solar positioning systems use an optical means to direct the solar tracking device. These solar tracking strategies use optical tracking techniques, such as a sun sensor means, to direct sun rays onto a silicon or CMOS substrate to determine the X and Y coordinates of the sun's position. In a solar mems sun-sensor device, incident sunlight enters the sun sensor through a small pin-hole in a mask plate where light is exposed to a silicon substrate. In a web-camera or camera image processing sun tracking and sun following means, object tracking software performs multi object tracking or moving object tracking methods. In an solar object tracking technique, image processing software performs mathematical processing to box the outline of the apparent solar disc or sun blob within the captured image frame, while sun-localization is performed with an edge detection algorithm to determine the solar vector coordinates. An automated positioning system help maximize the yields of solar power plants through solar tracking control to harness sun's energy. In such renewable energy systems, the solar panel positioning system uses a sun tracking techniques and a solar angle calculator in positioning PV panels in photovoltaic systems and concentrated photovoltaic CPV systems. Automatic on-axis solar tracking in a PV solar tracking system can be dual-axis sun tracking or single-axis sun solar tracking. It is known that a motorized positioning

Prinsloo, Robert Dobson, 2015-11-02 Free to download eBook on Practical Solar Tracking Design, Solar Tracking, Sun Tracking, Sun Tracker, Solar Tracker, Follow Sun, Sun Position calculation (Azimuth, Elevation, Zenith), Sun following, Sunrise, Sunset, Moon-phase, Moonrise, Moonset calculators. In harnessing power from the sun through a solar tracker or solar tracking system, renewable energy system developers require automatic solar tracking software and solar position algorithms. On-axis sun tracking system such as the altitude-azimuth dual axis or multi-axis solar tracker systems use a sun tracking algorithm or ray tracing sensors or software to ensure the sun's passage through the sky is traced with high precision in automated solar tracker applications, right through summer solstice, solar equinox and winter solstice. Eco Friendly and Environmentally Sustainable Micro Combined Solar Heat and Power (m-CHP, m-CCHP, m-CHCP) with Microgrid Storage and Layered Smartgrid Control towards Supplying Off-Grid Rural Villages in developing BRICS countries such as Africa, India, China and Brazil. Off-grid rural villages and isolated islands areas require mCHP and trigeneration solar power plants and associated isolated smart microgrid solutions to serve the community energy needs. This article describes the development progress for such a system, also referred to as solar polygeneration. The system includes a sun tracker mechanism wherein a parabolic dish or lenses are guided by a light sensitive mechanism in a way that the solar receiver is always at right angle to the solar radiation. Solar thermal energy is then either converted into electrical energy through a free piston Stirling, or stored in a thermal storage container. The project includes the thermodynamic modeling of the plant in Matlab Simulink as well as the development of an intelligent control approach that includes smart microgrid distribution and optimization. The book includes aspects in the simulation and optimization of stand-alone hybrid renewable energy systems and co-generation in isolated or islanded microgrids. It focusses on the stepwise development of a hybrid solar driven micro combined cooling heating and power (mCCHP) compact trigeneration polygeneration and thermal energy storage (TES) system with intelligent weather prediction, weak-ahead scheduling (time horizon), and look-ahead dispatch on integrated smart microgrid distribution principles. The solar harvesting and solar thermodynamic system includes an automatic sun tracking platform based on a PLC controlled mechatronic sun tracking system that follows the sun progressing across the sky. An intelligent energy management and adaptive learning control optimization approach is proposed for autonomous off-grid remote power applications, both for thermodynamic optimization and smart micro-grid optimization for distributed energy resources (DER). The correct resolution of this load-following multi objective optimization problem is a complex task because of the high number and multi-dimensional variables, the cross-correlation and interdependency between the energy streams as well as the non-linearity in the performance of some of the system components. Exergy-based control approaches for smartgrid topologies are considered in terms of the intelligence behind the safe and reliable operation of a microgrid in an automated system that can manage energy flow in electrical as well as thermal energy systems. The standalone micro-grid solution would be suitable for a rural village, intelligent building, district energy system, campus power, shopping mall centre, isolated network, eco estate or remote island application setting where self-generation and decentralized energy system concepts play a role. Discrete digital simulation models for the thermodynamic and active demand side management systems with digital smartgrid control unit to optimize the system energy management is currently under development. Parametric simulation models for this trigeneration system (polygeneration, poligeneration, quadgeneration) are developed on the Matlab Simulink and TrnSys platforms. In terms of model predictive coding strategies, the automation controller will perform multi-objective cost optimization for energy management on a microgrid level by managing the generation and storage of electrical, heat and cooling energies in layers. Each layer has its own set of smart microgrid priorities associated with user demand side cycle predictions. Mixed Integer Linear Programming and Neural network algorithms are being modeled to perform Multi Objective Control optimization as potential optimization and adaptive learning techniques.

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