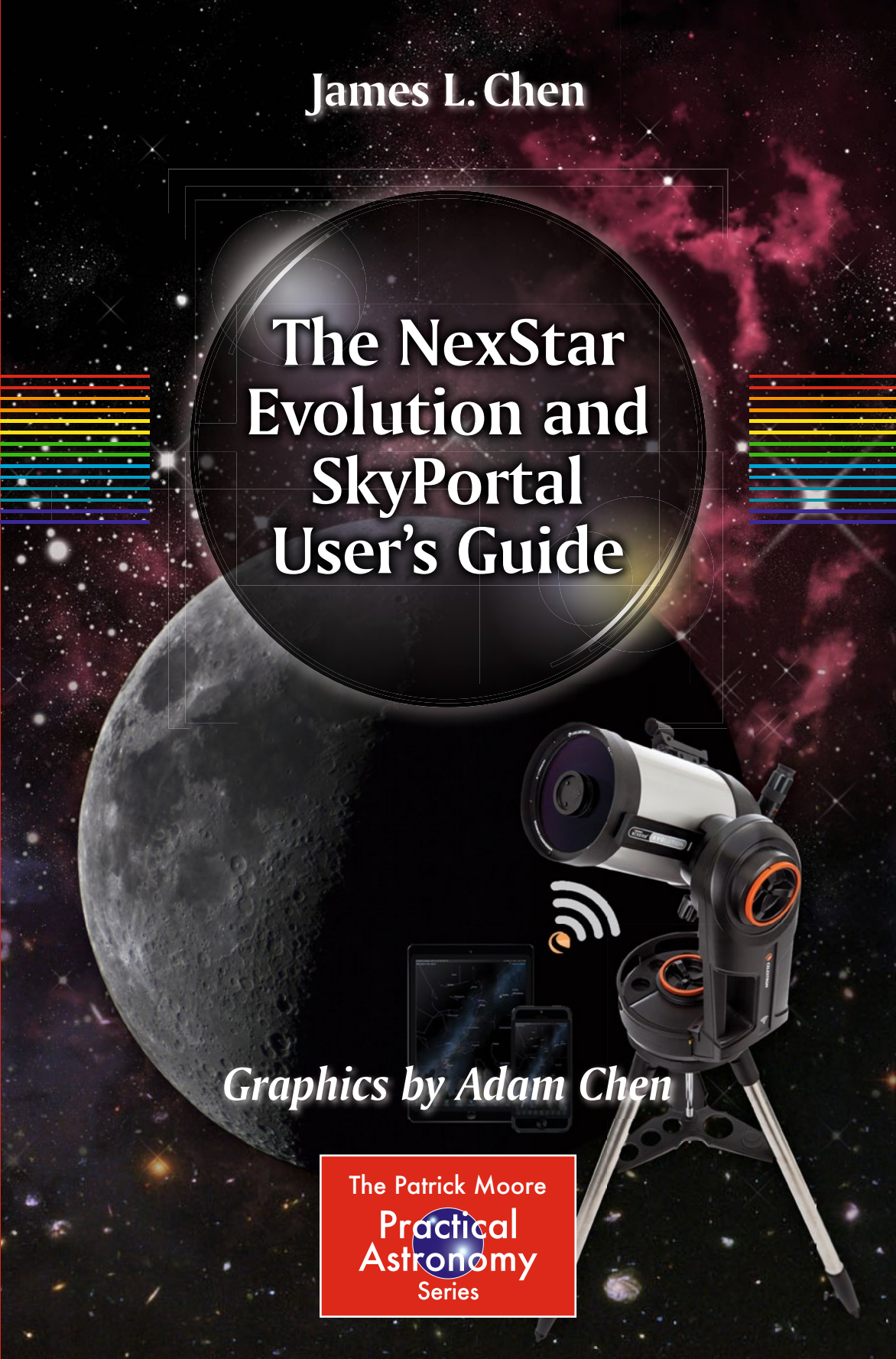
James L. Chen

The NexStar Evolution and SkyPortal User's Guide



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This book is dedicated to my friends
Helen and Steve,
and to Cheryl and Ray,
for their friendship and support over the years.

Other Books by James L. Chen

How to Find the Apollo Landing Sites
(The Patrick Moore's Practical Astronomy Series)
A Guide to Hubble Space Telescope Objects: Their Selection, Location, and Significance
(The Patrick Moore's Practical Astronomy Series)
The Vixen Star Book User's Guide
(The Patrick Moore's Practical Astronomy Series)

Preface

It is very likely that every amateur astronomer has owned a Celestron telescope at one time or another. And I am no exception. My experiences with Celestron telescopes began at the same time as my passion for backyard astronomy was reborn.

The Washington, D.C., area in the early 1980s was well known for George Washington Birthday sales. Every year, bargain hunters were treated to exceptional deals on all forms of consumer products, such as clothing, furniture, televisions, stereo electronics, and cameras. In 1987, a local Washington, D.C., camera store consolidated all its surplus camera and telescope items into its main warehouse for a true blowout George Washington's birthday sale. This particular sale included several Celestron telescopes that were unsold from the previous year's Halley's Comet sales push. My best friend and I entered the warehouse store and went crazy, with me leaving with two Celestron telescopes and an armful of eyepieces. My prized acquisitions were an orange tube Celestron C-5 with equatorial wedge and an orange tube C-90 Astro with fork mount and clock drive. The Celestron C-5 completely renewed my interest in astronomy. It also sparked a bad case of Gear Acquisition Syndrome, or sometimes known as GAS. In the next decade, I found myself building, buying, and selling many telescopes (including a self-built 10-in. Dobsonian telescope that resulted in my first published article in the November 1989 of Astronomy magazine). Along the way, both orange tube Celestron telescopes were sold. To this day, I wish I had kept that orange C-5.

By the early 1990s, I found myself owning a Celestron Ultima 8. The Ultima 8 was the ultimate expression of a pre-computerized 8-in. Schmidt-Cassegrain telescope, with heavy fork tines and an accurate clock drive system with hand controller. It was heavy, and boy was it stable. It had wonderful optics and was a joy to use, with the exception of having to move it in and out of the house. Alas, apochromatic

refractor fever got a hold of me, and the Ultima 8 was sold to finance a Brandon 130-mm apochromat refractor (which I still own). Another Celestron that I wish I had kept.

By the early 2000s, I had bought, traded, and bargained my way through several telescopes, culminating in the ownership of a classic Questar 3-1/2 in. Maksutov-Cassegrain, with a 1/10th wave quartz mirror. It was a wonderfully portable telescope system that accompanied me on a trip to Hawaii, the shores of the Chesapeake Bay to view and photograph the Venus transit of 2004, and several star parties. All was good with the Questar, except for the limitations of such a small aperture. In a clear case of aperture fever, the Questar was traded in for my current big eye telescope, a Celestron 11″ GPS. Eleven inches of aperture, GoTo and GPS drive system, and a versatile 2-in. diagonal, this Celestron has kept me happy for a decade. I don't miss the Questar!

I was working at a vendor booth at the 2014 NorthEast Astronomy Forum, conveniently known as NEAF, and was present at Celestron's product announcement of the Celestron Evolution series of telescopes. At an exclusive Celestron reception, Celestron introduced their new telescope line called the Celestron NexStar Evolution and a new 11-in. Rowe-Ackermann Astrograph.

The Celestron NexStar Evolution represents the latest developments in the long line of Schmidt-Cassegrain designs. The new Celestron Evolution line includes 6-in., 8-in., and 9.25-in. telescopes mounted on newly designed heavy duty single-arm fork mount with WiFi-based computer GOTO drive systems. Mechanically, the Celestron NexStar Evolution newly designed single-arm design is far sturdier than the older SE single-arm design and is steady enough for use in astrophotography.

Most notable is the introduction of a new GOTO computer control system. In the past, all telescope users are familiar with GOTO telescopes, with the hand controller and control cable attached to the base, and the power cables needed to provide power. This rat's nest of cables is eliminated with the new Celestron Evolution telescopes. The telescope base comes equipped with a built-in rechargeable battery. No longer does the user have to lug a separate battery pack to power the telescope or have a power cable cord getting in the way during a observing session.

Additionally, no longer is the telescope user encumbered with an archaic hand controller and the required telephone-like coiled controller cable. The Celestron NexStar Evolution utilizes a revolutionary WiFi interface with the user's tablet or smartphone to control the telescope. The user's iPhone, iPad, or Android tablet or phone is loaded with the SkyPortal application. The SkyPortal application is used to control the Evolution telescope, while providing the useful astronomy information.

The WiFi capability will save you if you have a pet dog like I do. I love my Labrador retriever Kaiser. He's a great dog, but sometimes he gets a little rambunctious and crazy. Not long ago, he got a hold of the Celestron NexStar+ hand control and chewed it up. I found the hand control on the floor, and the connecting cable had been chewed off by Kaiser. What was left of the cable and connectors were found in the corner of the family room, in a pool of yuk. Unfortunately, the hand control bore a slight resemblance to one of his chew toys! He had mistakenly taken

the hand control off my computer desk and proceeded to do his dog thing. Hence, I now place all my new hand controls in a glass cabinet for protection. My iPad, with the SkyPortal app, is safe from Kaiser's attacks.

Further NexStar Evolution refinements include tripods that now have gradations imprinted on the extendable legs to aid in leveling the mount on an uneven surface. Of course, a bubble level is built in on the tripod. There are even eyepiece spaces provided in both the tripod and drive base.

With the introduction of the NexStar Evolution series, I realized that a new era had dawned on amateur astronomy, and plans for this book took form. Within these pages, the description and process of using the novel WiFi-based control system provided by the NexStar Evolution and the SkyPortal applications are detailed. Note all photos of SkyPortal in action are taken from the screens of either an Apple iPad or an Apple iPhone 5C. The screens are identical with Android devices.

Clear Skies and Good Music,
James L. Chen

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Adam Chen is a Former Program Manager of media support for NASA Headquarters in Washington, D.C., and creator and executive producer of major NASA publications, including the book and web-book application documenting the history of the Space Shuttle Program "Celebrating 30 Years of the Space Shuttle Program." He served as graphics designer for all three James L. Chen's books and currently works in marketing for Brown Advisory, an investment firm in Baltimore, MD.

Chapter 1

A Brief History of Computerized Telescope Mounts for Amateurs

In the ultimate mating of two hobbies, computers and astronomy, computer controlled telescopes have captured the backyard astronomer's imagination and pocketbook. Known collectively as GoTo telescopes, this advanced technology is fascinating to watch in action as the mount proceeds to point the telescope from object to object with precision, accompanied with the sounds of motors whirring and gears meshing.

A GoTo telescope mount is quite simply a telescope system that is able to find celestial objects in the night sky, and then track them. The GoTo mount can be set up in an alt-azimuth or equatorial fashion, and after the proper alignment procedure, the finderscope is no longer needed for the rest of the evening. Some of the newer GoTo telescopes have electronics and CCD cameras that will perform the alignment procedure automatically.

These telescope mounts are wonderful pieces of technology. The GoTo technology allows for more efficient use of observing time by quickly finding objects in the night sky. Built into the hand controller is a microprocessor, firmware, and built-in memory catalog of the positions of thousands of stars, galaxies, nebulae, open star clusters, globular clusters, planetary nebulae, our solar system planets, and the Moon. Complex algorithms developed and refined over years with improvements in encoders and motor technology have made the GoTo telescope an accepted and desirable telescope feature. Computer controlled telescopes can help it's owner to overcome the fear of looking ridiculous while others watch; no longer will the telescope owner appear incompetent as he tries to find celestial wonders—now he only looks ridiculous as he tries to remember how to set up his telescope!

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There is an ongoing debate within the amateur astronomy community on the merits of computer guided and computer controlled telescopes. The hardcore conservative backyard astronomers argue that a beginner or novice individual is better served learning the skies without electronic aids, as generations of stargazers have done. There is merit to this argument. However, in these days of increasing light pollution in urban and suburban neighborhoods, seeing landmark stars used for "starhopping" to locate deep sky objects is becoming increasingly difficult and frustrating to a backyard astronomer, particularly to the beginner or novice. Using bright first magnitude stars for alignment, a computerized GoTo system eliminates frustration and introduces fun into the hobby. The search time for a celestial object is reduced from tens of minutes to mere seconds! With the electronics aiding the observer in finding the deep sky objects, a suburban observer can then take advantage of modern filter technology in overcoming the light pollution in their area. Cheers to the miracle of nebula filters, light pollution filters, and color filters!

Of course, in the worst of urban environments, even using a GoTo telescope and mount can be challenging, especially if bright stars are impossible to see for alignment purposes or otherwise. For instance, in the the middle of brightly lit Las Vegas, the only bright stars visible are Wayne Newton, Celine Dion, and a variety of Elvis impersonators!

The era of computerized GoTo telescopes began in 1984. Computer controlled telescopes took form during the same period as the development of personal computers. During the 1980s, the US telescope company Celestron formed a business relationship with Vixen Company, Ltd of Japan. The American company featured its home grown Schmidt-Cassegrain telescope, while importing the Japanese refractors, eyepieces, and equatorial mounts from Vixen, and marketing them under the Celestron brand. The Sky Sensor was an economical system consisting of a GoTo computer control system with motors designed to attach onto their portable German equatorial mount known as the Super Polaris. The landmark Sky Sensor system was remarkable for its time. As the first consumer affordable GoTo system, it had 472 nebulae, star clusters, and galaxies stored in its memory. This is small, as compared to today's GoTo systems that have 30,000, 40,000, or more deep sky objects stored in their databases.

The reader is cautioned to understand that database claims are sometimes inflated and not necessarily truthful. There are a number of multiple counts for a single object. For instance, the Andromeda Galaxy counts as one object; M31 is an additional object; NGC 224 as another object. Thus the same object is counted as three separate objects in some manufacturer's database claims.

The Sky Sensor was revolutionary in 1984. The Sky Sensor data base contained all the Messier objects, NGC objects brighter than tenth magnitude, and 285 stars brighter than 3.5 magnitude.

Installation of the Sky Sensor onto a Super Polaris mount required a little mechanical dexterity, but could be handled by the end user. And if not, the local dealers were experienced in installing the right ascension motor and electronics card, declination motor and electronics card, gear shafts and pressure plates, and clutch knobs. Plug in the Sky Sensor controller and power supply, and the system was ready for use.

Fig. 1.1 The Sky Sensor computer controller (Hands-on-Optics Used Equipment archives)

The keyboard, as seen in Fig. 1.1 was a bit archaic. Note the use of CR for carriage return instead of an Enter key! The art of human factors engineering had not yet entered into the design of telescope control. The end user faced a bit of a learning curve in operating the Sky Sensor. The system was not as responsive, accurate, nor as quick as today's modern GoTo systems, but as a first generation device it showed the way to the future.

Introduced in 1987, Celestron Compustar 8 was the first computer controlled telescope offered for the consumer. The Compustar 8 was large, heavy, and difficult to produce. The history of Celestron GoTo telescopes is detailed in the next chapter.

In 1992, Meade Instruments introduced the LX200 series of fork mounted Schmidt-Cassegrain telescopes (SCT). Early 8 and 10 in. models that were produced contained software bugs and were unreliable telescopes. Over time Meade was able to refine the LX200 models to become a very capable platform, with the product line extending to larger models, of 12 and 16 in. sizes, telescopes more at home in a college or NASA observatory than in the backyard. In August 1996 Celestron countered with the Ultima 2000 series telescopes—but they delayed shipping until 1997 until the software bugs were worked out. The initial offering was an 8 in. SCT Ultima 2000, which was a lightweight, rigid, and easy to use telescope (Fig. 1.2).

Fig. 1.2 The Vixen Sky Sensor 3 (Hands-on-Optics Used Equipment archives)

Meanwhile in the late 1990s, Vixen issued a revised version of their GoTo system, named the Sky Sensor 3. The Sky Sensor 3 featured an updated hand controller and other hardware. The database was still the same size (Fig. 1.3).

By 2000, Vixen introduced another revision to their venerable Sky Sensor series, now known as the Sky Sensor 2000. The SkySensor 2000 system was vastly refined and improved over the previous Sky Sensor models. The SkySensor 2000 could be retrofitted for use with the Vixen GP, GP-DX, GP-E, SP or SP-DX equatorial mounts to provide highly accurate "Go To" pointing and tracking of celestial objects in a vastly expanded data base that now included the planets, Moon, Sun, and thousands of deep sky objects from Messier, NGC, IC, UGC, SAO, and GCVS catalogs, for a total of 13,942 celestial objects.

The revised system simplified the initial setup and was easier to operate. The slewing rate was improved up to 1200× that of Sidereal rate (5–3/4 deg. per second). The Sky Sensor 2000 incorporated the most accurate of the tracking control systems for the time by including Periodic Error Correction (PEC) circuitry to reduce the amplitude of worm gear periodic errors.

In the new millennia, major developments in GoTo telescope technology have been introduced into the consumer market. Meade and Celestron have introduced and refined their Autostar and Nexstar GoTo systems for fork mount and German mount designs. Databases of these telescope computer systems have been expanded to the 30,000–40,000 celestial objects range, including entire Messier, Caldwell, NCG, and IC catalogs of deep sky objects. Databases now include extensive lists of