The History of the Easy Suite

The first easy files (easy1–easy10) were published in the periodical GPS Solutions in 2003, 7:47–51. At that time RINEX version 2.10 was widely used. This first easy-suite was augmented by a continuation (easy11–easy18) in InsideGNSS in the years 2009–2010. During recent years numerous requests for an update to RINEX version 3.03 arrived. This is natural since 25 years have passed between the early and the present RINEX version.

A comprehensive description of the individual *easy*-files can be found in Chapters 9 and 10 of the textbook by Kai Borre & Gilbert Strang (2012) *Algorithms for Global Positioning*, Wellesley-Cambridge Press.

The Matlab programming language has undergone some developments, too. The new code is based on Matlab version 8.5 (R2015a).

The update involves a renumbering of a few scripts in order to avoid the file identification being a combination of a number and a letter. The update was a major undertaking as RINEX version 3.03 uses a more flexible format than was allowed for version 2.10.

I tried to find an optimum way of coding. Optimum in the sense that it still is useful as a teaching code which is easy to modify, and also not exploiting too sophisticated tricks.

Many users unfamiliar to Matlab complained that this or that file was missing. One solution to this situation is to avoid using functions too often or include them at the bottom of the script files. Again this results in more code lines, but hopefully the difficulty with seemingly missing functions is eliminated.

Somebody would likely appreciate that I used cells and structures more extensively in the code. My argument is that I still want to keep the newcomer in focus and I judge the mentioned efficient augmentation only would complicate the learning process.

Again the suite is described in the textbook Kai Borre & Gilbert Strang (2012) Algorithms for Global Positioning. Wellesley-Cambridge Press.

This new package of Easy-files must not be mixed with any earlier code. Some of the scripts and functions carry the same name, but most often they have been modified.

When introducing new code, it is inevitable that it contains bugs. The earlier easy-suite had reached a stable stage. I no longer receive hints on repairing code. So either the code is perfect, or no one uses it.

New Data Set

The present version is based on a new data set which is collected with two Javad Delta_3 receivers. About 15 minutes of data from two antennas 0.6 meter apart and using 1 second epoch intervals. The site is on top of the main building of Samara State Aerospace University. The approximate coordinates are latitude $\varphi = 53^\circ 12' 43.2''$, longitude $\lambda = 50^\circ 10' 39.5''$, and ellipsoidal height $h = 150$ meter.

The data include only GPS observations. For a newcomer it would be too complicated to include for example GLONASS. However, we work on publishing

Table 1: Topics Treated in the EASY Suite

Name	Topic
easy1	time conversion: Time, UTC, GPST, week number, and sow
easy2	Kepler's law, computation of a satellite's position from an ephemeris
easy3	computation of a receiver's position in ECEF coordinates from pseudoranges
easy4	computation of a baseline from pseudoranges alone
easy5	computation of a baseline from pseudorange and phase observations using a least-squares solution
easy6	the same as *easy5*, but using a Kalman filter for the baseline estimation
easy7	estimation of receiver clock offset
easy8	check of cycle slips
easy9	various coordinate representations of a given baseline
easy10	estimation of ionospheric delay for the individual satellites
easy11	stereographic sky plot of satellite orbits and plot of time when satellites are above a given local horizon
easy12	details of the LAMBDA method, explained through a small numerical example
easy13	receiver autonomous integrity monitoring (RAIM), horizontal protection level (HPL), and vertical protection level (VPL)
easy14	sample of space based augmentation system (SBAS), corrected positions and their presentation in Stanford plots
easy15	accuracy comparison between pseudorange based stand-alone positions, baselines computed using pseudoranges alone, and combined pseudorange and carrier phase observations
easy16	error analysis of a selected one-way observation
easy17	satellite orbits in inertial and Earth-centered, Earth-fixed (ECEF) systems, and curve defined by sub-satellite points
easy18	the same as *easy5*, but introducing downweighting of older observations
easy19	computation of differential corrections at a base station

a book on Matlab receivers for GPS, GLONASS, BeiDou, and Galileo, mainly single-frequency receivers. Other useful material in the book is a snap-shot receiver; all receivers are coded to start from output as coming from a common front-end that can be purchased.

Acknowledgement

This work was supported by Samara State Aerospace University. The actual job was done August 2015–February 2016.