



# PAL – A Positional Astronomy Library

Tim Jenness and David S. Berry  
Joint Astronomy Centre

Patrick Wallace's SLALIB library is a very popular positional astronomy library that is available in Fortran as part of the Starlink Software Collection with a GPL license. An updated version is also available directly from the author as a proprietary and extended C library with a non-commercial non-redistribution license. The latter clause makes it hard to ship software relying on the C library and impossible to include the code in a public source code repository.

To overcome the distribution issues and to make use of current precession and nutation models, we have written, with advice and input from Patrick Wallace, the PAL library. The PAL library is written in C and has a GPL license. In most cases the API is designed to be identical to SLALIB except for the use of a PAL prefix instead of a SLA prefix in function calls. Where appropriate, IAU SOFA routines, of which Patrick Wallace was the primary author, are called. Where the SOFA library does not have equivalent functionality the Fortran has been ported to C from the GPL Fortran library included with the Starlink distribution.

We have not ported the full SLALIB functionality to PAL but are adding routines as we need them for applications. Approximately 100 functions have been ported.

## SLALIB Fortran:

```
GMST = SLA_GMST( UT1 )  
CALL SLA_DE2H( HIN, DIN, DP, DA, DE )  
CALL SLA_DMOON( DATE, PV )
```

## SLALIB C:

```
gmst = slaGmst( ut1 );  
slaDe2h( hin, din, dp, &da, &de );  
slaDmoon( date, pv );
```

## PAL C:

```
gmst = palGmst( ut1 );  
palDe2h( hin, din, dp, &da, &de );  
palDmoon( date, pv );
```

## PAL Python:

```
import palpy as pal  
gmst = pal.gmst( ut1 )  
(da, de) = pal.de2h( hin, din, dp )  
pv = pal.dmoon( date )
```

## PAL Perl:

```
use Astro::PAL qw/ :all /;  
$gmst = palGmst( $ut1 );  
($da,$de) = palDe2h( $hin, $din, $dp );  
@pv = palDmoon( $date );
```

The Fortran test suite was ported to C to test the PAL library. There are minor differences due to differences in the more modern precession and nutation models implemented in SOFA.

The PAL library is now used within the Starlink AST library and in all Starlink C applications that previously used SLALIB. It was shipped with the Starlink *kapuahi* release (see Poster **P05**).

The PAL library also has an advantage over Fortran SLALIB in that it is inherently thread-safe.

## Availability

PAL is available from GitHub ([github.com/Starlink/pal/downloads](https://github.com/Starlink/pal/downloads)) and is also distributed with Starlink ([www.starlink.ac.uk](http://www.starlink.ac.uk)).

It can also be installed using the PALpy package on PyPI and the Perl module (Astro::PAL) can be downloaded from CPAN. Both PALpy and Astro::PAL have public source code repositories on github and they are both distributed with their own copies of PAL and SOFA to make installation simple.