

Package ‘Carlson’

January 20, 2025

Type Package

Title Carlson Elliptic Integrals and Incomplete Elliptic Integrals

Version 3.0.0

Date 2023-11-10

Author Stéphane Laurent

Maintainer Stéphane Laurent <laurent_step@outlook.fr>

Description Evaluation of the Carlson elliptic integrals and the incomplete elliptic integrals with complex arguments. The implementations use Carlson's algorithms <doi:10.1007/BF02198293>. Applications of elliptic integrals include probability distributions, geometry, physics, mechanics, electrodynamics, statistical mechanics, astronomy, geodesy, geodesics on conics, and magnetic field calculations.

License GPL-3

URL <https://github.com/stla/Carlson>

BugReports <https://github.com/stla/Carlson/issues>

Imports Rcpp

LinkingTo Rcpp

Suggests gsl, testthat

Encoding UTF-8

RoxygenNote 7.2.3

NeedsCompilation yes

Repository CRAN

Date/Publication 2023-11-10 19:33:25 UTC

Contents

Carlson_RC	2
Carlson_RD	3

Carlson_RF	3
Carlson_RG	4
Carlson_RJ	4
elliptic_E	5
elliptic_F	6
elliptic_PI	6
elliptic_Z	7
Lambda0	7
Index	9

Carlson_RC	<i>Carlson elliptic integral RC</i>
------------	-------------------------------------

Description

Evaluate the Carlson elliptic integral RC.

Usage

```
Carlson_RC(x, y, minerror = 1e-15)
```

Arguments

x, y	real or complex numbers, with y different from 0
minerror	bound on the relative error passed to Carlson_RF

Value

A complex number, the value of the Carlson elliptic integral $R_C(x, y)$.

Note

The function returns a value when x or y are negative real numbers, but this value is not the one of the Carlson integral.

Examples

```
Carlson_RC(5, 2)
gsl::ellint_RC(5, 2)
```

Carlson_RD	<i>Carlson elliptic integral RD</i>
------------	-------------------------------------

Description

Evaluate the Carlson elliptic integral RD.

Usage

```
Carlson_RD(x, y, z, minerror = 1e-15)
```

Arguments

x, y, z	real or complex numbers; at most one can be 0
minerror	bound on the relative error

Value

A complex number, the value of the Carlson elliptic integral $R_D(x, y, z)$.

Note

The function returns a value when x, y or z are negative real numbers, but this value is not the one of the Carlson integral.

Examples

```
Carlson_RD(5, 2, 3)  
gsl::ellint_RD(5, 2, 3)
```

Carlson_RF	<i>Carlson elliptic integral RF</i>
------------	-------------------------------------

Description

Evaluate the Carlson elliptic integral RF.

Usage

```
Carlson_RF(x, y, z, minerror = 1e-15)
```

Arguments

x, y, z	real or complex numbers; at most one can be 0
minerror	bound on relative error

Value

A complex number, the value of the Carlson elliptic integral $R_F(x, y, z)$.

Note

The function returns a value when x , y or z are negative real numbers, but this value is not the one of the Carlson integral.

Examples

```
Carlson_RF(5, 2, 3)
gsl::ellint_RF(5, 2, 3)
```

Carlson_RG	<i>Carlson elliptic integral RG</i>
------------	-------------------------------------

Description

Evaluate the Carlson elliptic integral RG.

Usage

```
Carlson_RG(x, y, z, minerror = 1e-15)
```

Arguments

x, y, z	real or complex numbers; they can be zero
minerror	bound on the relative error passed to Carlson_RF and Carlson_RD

Value

A complex number, the value of the Carlson elliptic integral $R_G(x, y, z)$.

Carlson_RJ	<i>Carlson elliptic integral RJ</i>
------------	-------------------------------------

Description

Evaluate the Carlson elliptic integral RJ.

Usage

```
Carlson_RJ(x, y, z, p, minerror = 1e-15)
```

Arguments

x, y, z, p real or complex numbers; at most one can be 0
 minerror bound on the relative error

Value

A complex number, the value of the Carlson elliptic integral $R_J(x, y, z, t)$.

Note

The function returns a value when x, y, z or p are negative real numbers, but this value is not the one of the Carlson integral.

Examples

```
Carlson_RJ(5, 2, 3, 4)
gsl::ellint_RJ(5, 2, 3, 4)
```

 elliptic_E

Incomplete elliptic integral of the second kind

Description

Evaluate the incomplete elliptic integral of the second kind.

Usage

```
elliptic_E(phi, m, minerror = 1e-15)
```

Arguments

phi amplitude, real or complex number/vector
 m parameter, real or complex number/vector
 minerror the bound on the relative error passed to [Carlson_RF](#) and [Carlson_RD](#)

Value

A complex number or vector, the value(s) of the incomplete elliptic integral $E(\phi, m)$.

Examples

```
elliptic_E(1, 0.2)
gsl::ellint_E(1, sqrt(0.2))
```

elliptic_F *Incomplete elliptic integral of the first kind*

Description

Evaluate the incomplete elliptic integral of the first kind.

Usage

```
elliptic_F(phi, m, minerror = 1e-15)
```

Arguments

phi	amplitude, real or complex number/vector
m	parameter, real or complex number/vectot
minerror	the bound on the relative error passed to Carlson_RF

Value

A complex number or vector, the value(s) of the incomplete elliptic integral $F(\phi, m)$.

Examples

```
elliptic_F(1, 0.2)
gsl::ellint_F(1, sqrt(0.2))
```

elliptic_PI *Incomplete elliptic integral of the third kind*

Description

Evaluate the incomplete elliptic integral of the third kind.

Usage

```
elliptic_PI(phi, n, m, minerror = 1e-15)
```

Arguments

phi	amplitude, real or complex number/vector
n	characteristic, real or complex number/vector
m	parameter, real or complex number/vector
minerror	the bound on the relative error passed to Carlson_RF and Carlson_RJ

Value

A complex number or vector, the value(s) of the incomplete elliptic integral $\Pi(\phi, n, m)$.

Examples

```
elliptic_PI(1, 0.8, 0.2)
gsl::ellint_P(1, sqrt(0.2), -0.8)
```

elliptic_Z	<i>Jacobi zeta function</i>
------------	-----------------------------

Description

Evaluate the Jacobi zeta function.

Usage

```
elliptic_Z(phi, m, minerror = 1e-15)
```

Arguments

phi	amplitude, real or complex number/vector
m	parameter, real or complex number/vector
minerror	bound on relative error passed to elliptic_E and elliptic_F

Value

A complex number or vector, the value(s) of the Jacobi zeta function $Z(\phi, m)$.

Lambda0	<i>Heuman Lambda function</i>
---------	-------------------------------

Description

Evaluates the Heuman Lambda function.

Usage

```
Lambda0(phi, m, minerror = 1e-14)
```

Arguments

phi	Jacobi amplitude, a complex number/vector
m	parameter, a complex number/vector
minerror	the bound on the relative error passed to elliptic_F and elliptic_Z

8

*Lambda*0

Value

A complex number or vector.

Index

Carlson_RC, 2
Carlson_RD, 3, 4, 5
Carlson_RF, 2, 3, 4–6
Carlson_RG, 4
Carlson_RJ, 4, 6

elliptic_E, 5, 7
elliptic_F, 6, 7
elliptic_PI, 6
elliptic_Z, 7, 7

Lambda0, 7