Subject: Re: matrix log and exp
Posted by James Kuyper on Wed, 17 Apr 2002 21:52:26 GMT
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Paul Van Delst wrote:

> G Karas wrote:
>
>> Hi group,
>> one quickie and possibly difficult:
>>
>> IDL does not have a matrix logarithm logm and matrix
>> exponent expm function. I was thinking of calling lapack
>> routines which do it, but have no experience with lapack
>> or FORTRAN. Anyone with any tips on this one?
>
>
> Yes. Use ALOG() and EXP().
>
> paulv

He's talking about matrix logarithm and exponent, not the element-by-element logarithm and exponent. When you calculate exp(matrix), it produces a new matrix, each of whos elements is exp() of the corresponding element of the input matrix.

That's very different from the matrix exponential function of x, which is defined only for square matrices. It uses the same Taylor series expansion:

1 + x + x^2/2! + x^3/3! + x^4/4! ...

but interprets '1' as the identity matrix of the appropriate size, and x^n as the matrix multiplication of x by itself n times.

For instance:

```
IDL> A = [[0,1],[1,0]]
IDL> print, exp(A)
      1.00000      2.71828
      2.71828      1.00000
```

Since, for matrix multiplication, A^n = A if n is odd, and A^n=[[1,0],[0,1]] if n is even, the diagonal elements pick up the even terms of the exponential series, and the off-diagonal terms pick up odd terms. Those series are easily summed analytically, giving a matrix exponential of A as:

```
IDL> print, [[cosh(1),sinh(1)],[sinh(1),cosh(1)]]
      1.54308      1.17520
      1.17520      1.54308
```

Which is quite a bit different from exp(A).
