Tips !

Serge Iovleff

1 Tips: Centering an array

It' very easy to center a data set using high level templated expressions and statistical functors.

Listing 1: Example

```
#include "STKpp.h"
using namespace STK;
int main(int argc, char *argv[])
{
  CArrayXX A(100, 5);
  Law::Normal law(1,2);
  A.rand(law);
  // call column statistical functions
  stk_cout << _T("min(A) =") << Stat::min(A);
  stk_cout << _T("max(A) =") << Stat::max(A);
  stk_cout << _T("max(A.abs()) =") << Stat::max(A.abs());
  stk_cout << _T("mean(A) =") << Stat::mean(A);
  // center the array
  stk_cout << _T("\nCentering...\n\n");
  A -= Const::VectorX(100) * Stat::mean(A);
  // call column statistical functions with all the columns of A
       centered
  stk_cout << _T("min(A) =") << Stat::min(A);
  stk_cout << _T("max(A) =") << Stat::max(A);
  stk_cout << _T("max(A.abs()) =") << Stat::max(A.abs());
  stk_cout << _T("mean(A) =") << Stat::mean(A);
}
```

Listing 1: Output

```
min(A) =-4.97337 -5.78026 -4.31822
     -4.57376 -5.07644
max(A) =5.43914 6.08959 6.91138
     6.751 6.38354
max(A.abs()) =5.43914 6.08959
     6.91138 6.751 6.38354
mean(A) =1.0716 0.52359 0.799776
     1.37117 0.818364

Centering...

min(A) =-6.04498 -6.30385 -5.11799
     -5.94494 -5.8948
max(A) =4.36754 5.566 6.1116
     5.37983 5.56517
max(A.abs()) =6.04498 6.30385
     6.1116 5.94494 5.8948
mean(A) =1.04361e-16 6.55032e-17
     3.24185e-16 -5.41789e-16
     2.30926e-16
```

the expression

```
Const::Vector<Real>(100)mean(A)
```

represents the matrix multiplication of a column vector of 1 with 100 rows and of row vector with the mean of each column of A.

Note:
For each column of the array `A` we can get the maximal value in absolute value using `max(A.abs())`. It is possible to use functors mixed with unary or binary operators.

2 Tips: Compute the mean for each column of an array

You can easily get the mean of a whole vector or a matrix containing missing values using the expression

```
  CArray<Real> A(100, 20);
  Law::Normal law(1,2);
  A.rand(law);
  Real m = A.meanSafe();
```

In some cases you may want to get the mean for each column of an array with missing values. You can get it in a @c PointX vector using either the code

```
  PointX m;
  m = meanByCol(A.safe()); // mean(A.safe()); is shorter
```

or the code

```
Array2DPoint<Real> m;
m.move(Stat::mean(A.safe()));
```

The method `A.safe()` will replace any missing (or NaN) values by zero. In some cases it's not sufficient, Suppose you know your data are all positive and you want to compute the log-mean of your data. In this case, you will rather use

```
m = Stat::mean(A.safe(1.).log());
```

and all missing (or NaN) values will be replaced by one.

Note:
You can also compute the variance. If you want to compute the mean of each row, you will have to use the functor `Stat::meanByRow`. In this latter case, you get a `VectorX` as result.

3 Tips: Compute the mean and the variance of multidimensionnal data

You can easily compute the mean and the variance matrix of multidimensional data. Assume we are handling this kind of data

```
// values (b,g,r,ir)
typedef CArrayVector<double, 4> Spectrum;
```

repeated in space and time. The data are stored in an array

```
// array of values
typedef CArray<Spectrum> ArraySpectrum;
ArraySpectrum dataït;
```

and we want to compute at each time the (multidimensional) mean of this data set. This can be used using the following code :

```
// array of mean values
typedef CArrayPoint<Spectrum> PointSpectrum;
PointSpectrum mut(datait.cols());
for (int t= datait.beginCols(); t< datait.endCols(); ++t)
{
  mut[t] = 0.;
  for (int i=datait_.beginRows(); i< datait_.endRows(); ++i)
  { mut[t] += datait_(i,t);}
  mut[t]/= data.sizeRows();
}
```

The variance matrix (using numerical correction) can be computed using the following code :

```
// covariances values (b,g,r,ir)
typedef CArraySquare<double, 4> CovSpectrum;
// array of mean values
typedef CArrayPoint<CovSpectrum> PointCov;
PointSpectrum sigmat(datait.cols());
for (int t= datait.beginCols(); t< datait.endCols(); ++t)
{
  CovSpectrum var; var=0.0;
  Spectrum sum = 0.0;
  for (int i=datait_.beginRows(); i< datait_.endRows(); ++i)
  {
    Spectrum dev;
    sum += (dev = datait(i,t) - mut[t]);
    var += devdev.transpose();
  }
  sigmat[t] = (var - ((sumsum.transpose())/datait.sizeCols()) )/datait.sizeCols();
}
```

STK++ handles transparently the multidimensional nature of the data.