APPENDICE A

Un exemple de session en Scratchpad II

On donne à titre d'exemple une session de démonstration qui illustre les possibilités offertes par l'implantation réalisée en Scratchpad II des méthodes décrites au chap. V § 5.

```
)r demo1
     reading file DEMO1 INPUT A1
     Scratchpad
  )lo conp idpack structls

     loading CONP LISPLIB A1 for package ConvPack
     library CONP has been loaded and is now exposed.
     loading IDPACK LISPLIB A1 for package IdentifiabilitePackage
     library IDPACK has been loaded and is now exposed.
     loading STRUCTLS LISPLIB A1 for domain StructureLineaireStationnaire
     library STRUCTLS has been loaded and is now exposed.
  )time on

   St:=STRUCTLS
     loading LIBNAME LISPLIB K2 for domain LibraryName
     loading FNAME LISPLIB K2 for domain FileName
     loading RF LISPLIB K2 for domain RationalFunction
     loading KAF LISPLIB K1 for domain KeyedAccessFile

     (1)  STRUCTLS

     Type: DOMAIN  .536 (IN) + 7.138 (OT) = 7.674 sec

   -- comment entrer une structure

   strSimp:=new(2,1,1,[th1,th2,th3])$St

     (2)
     dX  |0  0|    |0|
     --= |    |X + | |U
     dt  |0  0|    |0|
     Y = [0  0]X
     Parametres internes = [th1,th2,th3]
```

```
  Type: STRUCTLS  .283 (IN) + .234 (EV) + .297 (OT) = .814 sec

-- echange entre compartiments

etat(strSimp,1,2,th1)

  (3)
  dX  |- th1  0|    |0|
  --= |        |X + | |U
  dt  | th1   0|    |0|
  Y = [0  0]X
  Parametres internes = [th1,th2,th3]

  Type: STRUCTLS   .349 (IN) + .017 (EV) + .134 (OT) = .5 sec

etat(strSimp,2,1,th2)

  (4)
  dX  |- th1   th2 |    |0|
  --= |            |X + | |U
  dt  | th1   - th2|    |0|
  Y = [0  0]X
  Parametres internes = [th1,th2,th3]

  Type: STRUCTLS  .075 (IN) + .017 (EV) + .028 (OT) = .12 sec

-- sortie du systeme
etat(strSimp,2,th3-th2)

  (5)
  dX  |- th1   th2 |    |0|
  --= |            |X + | |U
  dt  | th1   - th3|    |0|
  Y = [0  0]X
  Parametres internes = [th1,th2,th3]

  Type: STRUCTLS  .203 (IN) + .036 (EV) + .1 (OT) = .339 sec
-- on commande le compartiment 1 com(strSimp,1,1,1)

  (6)
  dX  |- th1   th2 |    |1|
  --= |            |X + | |U
  dt  | th1   - th3|    |0|
  Y = [0  0]X
  Parametres internes = [th1,th2,th3]

  Type: STRUCTLS   .1 (IN) + .016 (EV) + .082 (OT) = .199 sec

-- on observe le compartiment 1
obs(strSimp,1,1,1)

  (7)
  dX  |- th1   th2 |    |1|
  --= |            |X + | |U
  dt  | th1   - th3|    |0|
  Y = [1  0]X
  Parametres internes = [th1,th2,th3]

  Type: STRUCTLS  .056 (IN) + .016 (EV) + .088 (OT) = .16 sec
```

```
-- voici la structure strSimp

  (8)
  dX  |- th1   th2 |    |1|
  --= |            |X + | |U
  dt  | th1   - th3|    |0|
  Y = [1  0]X
  Parametres internes = [th1,th2,th3]

  Type: STRUCTLS  .004 (IN) + .024 (OT) = .027 sec

-- calcul du resume exhaustif pour la matrice de transfert
resumExhTransfert strSimp

  (9)  [th3,1,1,th3 + th1,th1 th3 - th1 th2]

  Type: L P I  .021 (IN) + 1.737 (EV) + .239 (OT) = 1.996 sec

-- test d'identifiabilite
identifiable?(strSimp,"Transfert")
  loading NDMP LISPLIB K1 for domain
  NewDistributedMultivariatePolynomial
  loading NDP LISPLIB K1 for domain NewDirectProduct
  loading OV LISPLIB K1 for domain OrderedVarlist
  loading GB LISPLIB K1 for package GroebnerPackage
  loading GBINTERN LISPLIB K1 for package GroebnerInternalPackage

  (10)  true

  Type: B   .094 (IN) + 8.584 (EV) + 5.198 (OT) + 2.04 (GC) = 15.916 sec

-- observation d'un bestiaire
-- exemples tires de la these de Y. Lecourtier, stockes sur disque
liLec:=liste("Lecourt these a")$St

  (11)
  ["methane p. 13", "exemple simple p. 31", "chimiotherapie p. 41", "p. 45",

   "p. 47", "premier passage p. 106", "premier passage theta5 = 0",

   "discernabilite exemple M p. 124", "discernabilite exemple M' p. 124"]


  Type: L S .096 (IN) + .467 (EV) + .179 (OT) = .742 sec

-- Un exemple: effet de premier passage d'un medicament
-- Voir ex. V.5.1.1
pp1:=get("Lecourt these a",liLec.6)$St

  (12)
      |- th2 - th1    0      0  |    |1|
  dX  |                         |    | |
  --= |    th1      - th3    0  |X + |0|U
  dt  |                         |    | |
      |    th2       th3   - th4|    |0|

      |0  th6   0 |
  Y = |           |X
```

```
       |0   0   th7|

  Parametres internes = [th1,th2,th3,th4,th6,th7]

  Type: Union(STRUCTLS,"failed")
          .654 (IN) + .122 (EV) + .333 (OT) = 1.11 sec

resumExhTransfert pp1

  (13)
  [(th2 + th1)th3 th7, th2 th7, 1, th4 + th3 + th2 + th1,

   (th3 + th2 + th1)th4 + (th2 + th1)th3, (th2 + th1)th3 th4, th1 th6, 1,

   th3 + th2 + th1, (th2 + th1)th3]


  Type: L P I  .026 (IN) + .648 (EV) + .038 (OT) = .712 sec

identifiable?(pp1,"Transfert")

  (14)  false

  Type: B.06 (IN) + 3.584 (EV) + .027 (OT) = 3.671 sec

-- Regardons la base standard
par:=lParms(pp1)$St

  (15)  [th1,th2,th3,th4,th6,th7]

  Type: L E .095 (IN) + .015 (EV) + .116 (OT) = .226 sec
ndmp:=NDMP(par,RF(I))

  (16)  NDMP([th1,th2,th3,th4,th6,th7],RF I)

  Type: DOMAIN         .088 (IN) + .062 (OT) = .15 sec

std:=zap(stdT(pp1))$ZAP(L E, L ndmp)
  loading ZAP LISPLIB K2 for package ZweitypeAlterationPackage

  (17)
                      2
      2   (- Th3 + Th2 - Th1)Th6       Th1 Th6
  [th6  + ---------------------- th6 + ---------,
                Th3 - Th2              Th3 - Th2

         Th3 - Th2
   th1 + --------- th6 - Th3 + Th2 - Th1, th2 - Th2,
           Th6

         - Th3 + Th2
   th3 + ----------- th6 - Th2, th4 - Th4, th7 - Th7]
            Th6


  Type: L NDMP([th1,th2,th3,th4,th6,th7],RF I)
          .172 (IN) + .037 (EV) + .597 (OT) = .805 sec
std.0
```

```
   2
          2   (- Th3 + Th2 - Th1)Th6       Th1 Th6
  (18)  th6  + ---------------------- th6 + --------
                    Th3 - Th2              Th3 - Th2

  Type: NDMP([th1,th2,th3,th4,th6,th7],RF I)
          .46 (IN) + .018 (EV) + .101 (OT) = .579 sec


-- d'apres la forme de la base standard, il y a deux solutions.
-- un exemple de discernabilite
dis1:St:=get("Lecourt these a","p. 45")$St

  (19)
  dX  |   - th1      th2 |    |1|
  --= |                 |X + | |U
  dt  |- th3 + th1  - th2|    |0|
  Y = [1  0]X
  Parametres internes = [th1,th2,th3]

  Type: STRUCTLS .097 (IN) + .104 (EV) + .044 (OT) = .246 sec
dis2:St:=get("Lecourt these a","p. 47")$St

  (20)
  dX  |   - th1     th2|    |1|
  --= |                |X + | |U
  dt  |- th3 + th1  - 1|    |0|
  Y = [1  0]X
  Parametres internes = [th1,th2,th3]

  Type: STRUCTLS .078 (IN) + .103 (EV) + .041 (OT) = .223 sec

Un exemple de discernabilite (voir V.5.2)
distingable?(dis1,dis2,"Transfert")

  (21)  true

  Type: Union(B,"failed") .077 (IN) + .32 (EV) + .092 (OT) = .488 sec

distingable?(dis2,dis1,"Transfert")

  (22)  false

  Type: Union(B,"failed") .064 (IN) + .09 (EV) + .021 (OT) = .175 sec
  0  total errors
```

Le fichier suivant correspond au traitement complet de l'exemple V.5.1.2.

```
)r demo2
  reading file DEMO2 INPUT A1
  Scratchpad

)time on
St:=STRUCTLS

  (23)  STRUCTLS

  Type: DOMAIN .096 (IN) + .262 (OT) = .358 sec
liRak:=liste("Raksanyi these a")$St
```

```
  (24)
  ["Synthese de l'ammoniacp. 117", "premier passage p. 121",

   "synthese de l'amoniac p. 117", "ammoniac", "ammoniac p. 115"]


  Type: L S .138 (IN) + .489 (EV) + .433 (OT) = 1.06 sec
Ammon:St:=get("Raksanyi these a",liRak.0)$St

  (25)
  dX
  --= matrix1 X + matrix2 U
  dt
  Y = matrix3 X
  Parametres internes = [f2,v13,v21,v31,v32]


where matrix1 =
  [[- f1 v31 - f1 v21 - f1 v01,f1 v12,f1 v13,0,0],

   [f2 v21,- f2 v32 - f2 v12,f2 v23,0,0],

   [f3 v31,f3 v32,- f3 v43 - f3 v23 - f3 v13,f3 v34,0],

   [0,0,f4 v43,- f4 v54 - f4 v34,f4 v45],

   [0,0,0,f5 v54,- f5 v45 - f5 v05]]


and matrix2 =
  |0|
  | |
  |0|
  | |
  |0|
  | |
  |0|
  | |
  |1|

and matrix3 =
  |0  0  0  0  1|
  |             |
  |1  0  0  0  0|

  Type: STRUCTLS .738 (IN) + .161 (EV) + .279 (OT) = 1.178 sec
matA:=a Ammon;

  Type: VOID .046 (IN) + .015 (EV) + .023 (OT) = .084 sec

-- On tient compte du fait que le systeme est stationnaire,
-- et qu'il y a donc des relations lineaires entre les parametres :
--   v45 = v01+-v54, v34 = v43+v01, v23 = v32+v01+v31-v13,
--   v12 = v01+v21+v31-v13, v = v01+v05.

for i in 0..2 repeat
  for j in 0..2 repeat
     matA.i.j:= eval(matA.i.j,[v45,v34,v23,v12,v],
                              [v01+v54,v43+v01,v32+v01+
```

```
                              v31-v13,v01+v21+v31-v13,v01+v05])

  Type: VOID 3.319 (IN) + 2.967 (EV) + .886 (OT) = 7.172 sec

-- Compte tenu de la forme particuliere de la structure,
-- un resume exhaustif s'obtient en considerant les coefficients
-- des polynomes caracteristiques des sous matrices principales
-- d'ordre 2 et 3

matA3Rf:M RF I:= new(3,3,0$RF(I));

  Type: VOID .276 (IN) + .027 (EV) + .282 (OT) = .585 sec for i in 0..2 repeat
 for j in 0..2 repeat
     matA3Rf.i.j:= matA.i.j

  Type: VOID
  14.928 (IN) + 1.664 (EV) + 1.036 (OT) + 2.22 (GC) = 19.848 sec

carF:= characteristicpol matA3Rf;
  loading EP LISPLIB K1 for package EigenPackage
  loading SOLVERAD LISPLIB K1 for package RadicalSolvePackage
  loading Q2ZPOLY LISPLIB K2 for package RationalToIntegerPolynomial
  loading RE LISPLIB K2 for domain RadicalExtension
  loading SR LISPLIB K2 for domain SortedRadicals
  loading DEGRED LISPLIB K2 for package DegreeReductionPackage
  loading SOLVEFOR LISPLIB K1 for package PolynomialSolveByFormulas
  loading EQ LISPLIB K2 for domain Equation
  loading SY LISPLIB K1 for domain Symbol
  loading SUCH LISPLIB K2 for domain SuchThat


  Type: VOID .189 (IN) + 4.728 (EV) + 17.681 (OT) + 4.55 (GC) = 27.147 sec

  -- Quelle horreur, pour calculer un polynome caracteristique...

carP:P I:=numer carF;

  Type: VOID .204 (IN) + .016 (EV) + .053 (OT) = .274 sec
carSUP:= likeUniv(carP,%A);

  Type: VOID .142 (IN) + .148 (EV) + .047 (OT) = .337 sec
resum3:=listCoef carSUP

  (33)

...

  Type: L P I .046 (IN) + .016 (EV) + .162 (OT) = .224 sec
matA2Rf:M RF I:= new(2,2,0$RF(I));

  Type: VOID .221 (IN) + .28 (EV) + .083 (OT) = .584 sec

for i in 0..1 repeat
 for j in 0..1 repeat
     matA2Rf.i.j:= matA.i.j

  Type: VOID 1.455 (IN) + .866 (EV) + .119 (OT) = 2.439 sec

carF:= characteristicpol matA2Rf;
```

```
  Type: VOID .055 (IN) + .785 (EV) + .018 (OT) = .857 sec

carP:P I:=numer carF;

  Type: VOID .087 (IN) + .017 (EV) + .024 (OT) = .128 sec
carSUP:= likeUniv(carP,%B);

  Type: VOID .118 (IN) + .05 (EV) + .015 (OT) = .183 sec
resum2:=listCoef carSUP

  (39)

...


  Type: L P I .039 (IN) + .018 (EV) + .045 (OT) = .102 sec

resum:= append(resum2,resum3)

  (40)

...


  Type: L P I .107 (IN) + .019 (EV) + .109 (OT) = .235 sec
resumExhSpecial(Ammon,resum);

  Type: VOID .038 (IN) + .017 (EV) + .071 (OT) = .126 sec
changeLE(Ammon,[v13,v21,v31,v32,f2])$St;

  Type: VOID .307 (IN) + .309 (EV) + .088 (OT) = .704 sec

identifiable?(Ammon,"Special")$St

  (43)  false

  Type: B .093 (IN) + 46.711 (EV) + 1.279 (OT) + 10.182 (GC) = 58.265 sec

par:=lParms(Ammon)$St;

  Type: VOID .303 (IN) + .303 (EV) + .092 (OT) = .698 sec
ndmp:=NDMP(par,RF(I))

  (45)  NDMP([v13,v21,v31,v32,f2],RF I)

  Type: DOMAIN .092 (IN) + .118 (OT) = .21 sec

std:=zap(stdS(Ammon))$ZAP(L E, L ndmp)

  (46)

...


  Type: L NDMP([v13,v21,v31,v32,f2],RF I)
          .184 (IN) + .036 (EV) + .399 (OT) = .619 sec

lIn:=[degree pol for pol in std]
```

```
(47)
[[1,1,0,0,0], [0,2,0,0,0], [1,0,0,1,0], [1,0,0,0,1], [0,1,0,0,1],

 [0,0,0,1,1], [0,0,1,0,0]]


Type: L NDP(5,NNI) .088 (IN) + .704 (EV) + .375 (OT) = 1.166 sec
```

On récupère ainsi la liste des multidegrés des monômes de tête, et l'on en conclut qu'il y a une infinité de solutions, car l'idéal est de dimension 1.