tScore
Makes Computers and Humans Talk About Time

Markus Lepper[a]   Baltasar Trancón y Widemann[ab]

[a]<semantics/> GmbH

[b]Universität Bayreuth

Sound und Performance
Bayreuth
4. – 7.10. 2012

markuslepper.eu

markuslepper.eu

What is tScore?

tScore is

a text format

for denotating arbitrary time-related structures.

markuslepper.eu

What is tScore?

tScore is

a text format

and the corresponding processing software framework

for denotating arbitrary time-related structures.

markuslepper.eu

Need of common notation

A common $\left\{ \begin{array}{c} \text{computer} \\ \text{human} \end{array} \right\}$ readable and writable language

for denotating arbitrary parameter ranges

in arbitrary time domains

is strongly desired !

markuslepper.eu

Need of common notation

(A concrete composition project as motivation :)

Unification of CWN and electronic control parameters
in one single human and computer readable score.

Existing (commercial/academic) systems lack flexibility/adaptability.

NOT due to "bad programming",
but due to lacks in preparatory analysis.

This analysis is a genuin application of informatics.
(I.e. computing science)

Informatics is a philosphical discipline.
Informatics is applied ontology, by a (re-)constructive approach.

markuslepper.eu

Need of common notation

(A concrete composition project as motivation :)

Unification of CWN and electronic control parameters
in one single human and computer readable score.

Existing (commercial/academic) systems lack flexibility/adaptability.

NOT due to "bad programming",
but due to lacks in preparatory analysis.

This analysis is a genuin application of informatics.
(I.e. computing science)

Informatics is a philosophical discipline.
Informatics is applied ontology, by a (re-)constructive approach.

markuslepper.eu

Need of common notation

(A concrete composition project as motivation :)

Unification of CWN and electronic control parameters
in one single human and computer readable score.

Existing (commercial/academic) systems lack flexibility/adaptability.

NOT due to "bad programming",
but due to lacks in preparatory analysis.

This analysis is a genuin application of informatics.
(I.e. computing science)

Informatics is a philosphical discipline.
Informatics is applied ontology, by a (re-)constructive approach.

markuslepper.eu

Need of common notation

(A concrete composition project as motivation :)

Unification of CWN and electronic control parameters
in one single human and computer readable score.

Existing (commercial/academic) systems lack flexibility/adaptability.

NOT due to "bad programming",
but due to lacks in preparatory analysis.

This analysis is a genuin application of informatics.
(I.e. computing science)

Informatics is a philosphical discipline.
Informatics is applied ontology, by a (re-)constructive approach.

markuslepper.eu

Need of common notation

(A concrete composition project as motivation :)

Unification of CWN and electronic control parameters
in one single human and computer readable score.

Existing (commercial/academic) systems lack flexibility/adaptability.

NOT due to "bad programming",
but due to lacks in preparatory analysis.

This analysis is a genuin application of informatics.
(I.e. computing science)

Informatics is a philosphical discipline.
Informatics is applied ontology, by a (re-)constructive approach.

markuslepper.eu

Need of common notation

(A concrete composition project as motivation :)

Unification of CWN and electronic control parameters
in one single human and computer readable score.

Existing (commercial/academic) systems lack flexibility/adaptability.

NOT due to "bad programming",
but due to lacks in preparatory analysis.

This analysis is a genuin application of informatics.
(I.e. computing science)

Informatics is a philosphical discipline.
Informatics is applied ontology, by a (re-)constructive approach.

markuslepper.eu

Need of common notation

- For what purpose?
    - automated performance (sequencing)
    - automated transformation / generation of temporal data
    - computer aided analysis
    - documentation
    - (multiple) type setting

- In which domain?
  Organizing which material?

    - light control
    - video cue lists
    - kinetic sculptures / robots
    - stage performance
    - music
    - (every other thinkable time-related structure)

markuslepper.eu

Need of common notation

- For what purpose?
  - – automated performance (sequencing)
  - – automated transformation / generation of temporal data
  - – computer aided analysis
  - – documentation
  - – (multiple) type setting

- In which domain?
  Organizing which material?

  - – light control
  - – video cue lists
  - – kinetic sculptures / robots
  - – stage performance
  - – music
  - – (every other thinkable time-related structure)

markuslepper.eu

Need of common notation

- For what purpose?
  - automated performance (sequencing)
  - automated transformation / generation of temporal data
  - computer aided analysis
  - documentation
  - (multiple) type setting
- In which domain?
  Organizing which material?

  - light control
  - video cue lists
  - kinetic sculptures / robots
  - stage performance
  - music
  - (every other thinkable time-related structure)

markuslepper.eu

Need of common notation

- For what purpose?
  - automated performance (sequencing)
  - automated transformation / generation of temporal data
  - computer aided analysis
  - documentation
  - (multiple) type setting

- In which domain?
  Organizing which material?
  - light control
  - video cue lists
  - kinetic sculptures / robots
  - stage performance
  - music
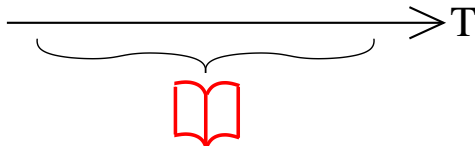 - *(every other thinkable time-related structure)*

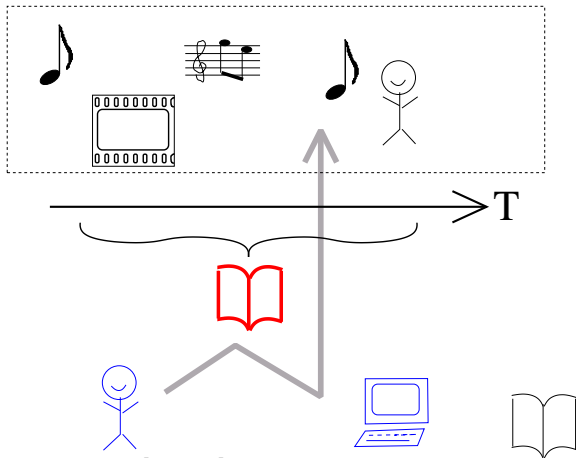markuslepper.eu
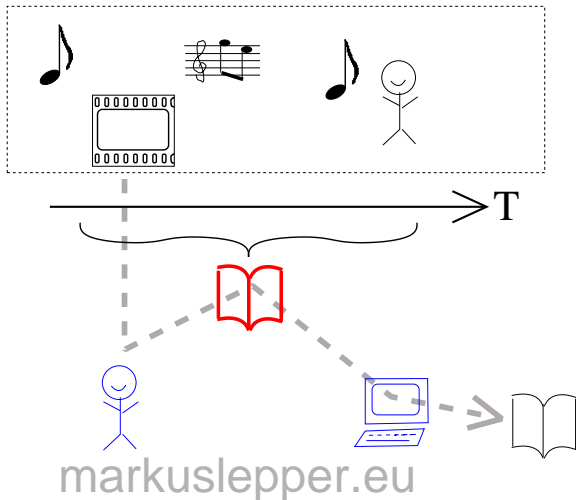
Use cases

markuslepper.eu

Use cases

Human writes score and computer executes.

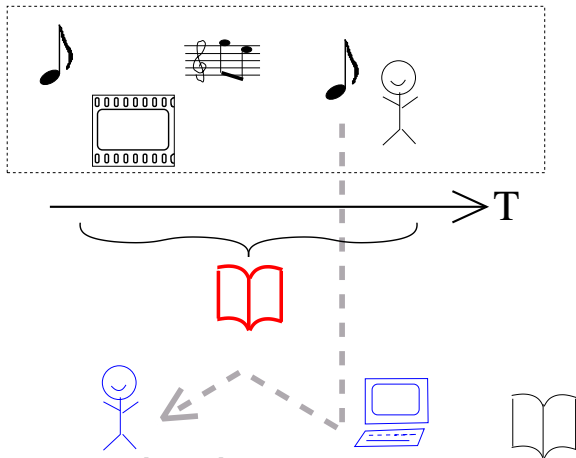## Use cases

Human writes protocol and computer renders.

Use cases

Computer recognizes and writes readable protocol.

markuslepper.eu

Use cases

What are the contents of such a language?

Simply mapping "Time"   to   "Parameter values"

$$\mathbb{T} \longrightarrow P_1 \times P_2 \times \ldots$$

(called "domain"   and   "range" . . .)

markuslepper.eu

What are the contents of such a language?

Simply mapping "Time"   to "Parameter values"

(this is SIMPLIFIED !-)

$$\mathbb{T} \longrightarrow P_1 \times P_2 \times \dots$$

(called "domain"   and   "range" ...)

markuslepper.eu

What are the contents of such a language?

Simply mapping "Time"   to   "Parameter values"

$$\mathbb{T} \longrightarrow P_1 \times P_2 \times \ldots$$

(called "domain"   and   "range" ...)

pure graphical notation
("analog", e.g. "Strecken-Notation")

dürstet, sollen satt werden

markuslepper.eu

What are the contents of such a language?

Simply mapping "Time"   to   "Parameter values"

$$\mathbb{T} \longrightarrow P_1 \times P_2 \times \ldots$$

(called "domain"   and   "range" …)

pure graphical notation
("analog", e.g. "Strecken-Notation")

```
\notes
\ibl0'ce0\qb0{_e_b}\tbl0\qb0{e}
\ibl0e0\qb0{_g{'_a}}\tbl0\qb0{`g}
\enotes
```

expressions
("symbolic", e.g. LilyPond, musixTex, Guido)

markuslepper.eu

What are the contents of such a language?

Simply mapping "Time"   to   "Parameter values"

$$\mathbb{T} \longrightarrow P_1 \times P_2 \times \ldots$$

(called "domain"   and   "range" ...)

pure graphical notation
("analog", e.g. "Strecken-Notation")

trad. musical notation

expressions

("symbolic", e.g. LilyPond, musixTex, Guido)
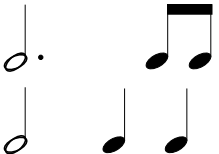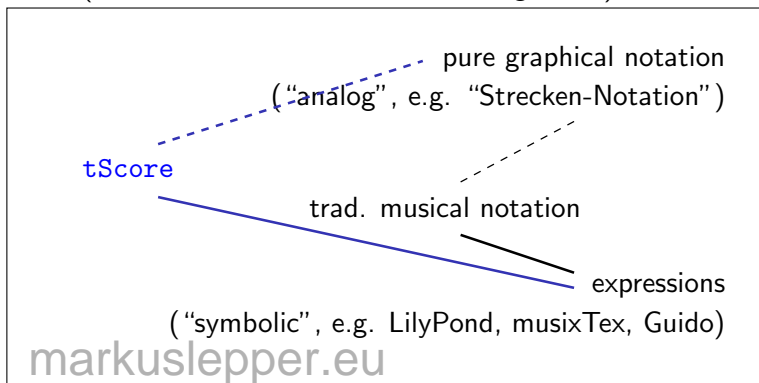
markuslepper.eu

What are the contents of such a language?

Simply mapping "Time"   to   "Parameter values"

$$\mathbb{T} \longrightarrow P_1 \times P_2 \times \ldots$$

(called "domain"   and   "range" ...)

pure graphical notation
("analog", e.g. "Strecken-Notation")

tScore

trad. musical notation

expressions

("symbolic", e.g. LilyPond, musixTex, Guido)

markuslepper.eu

tScore — **Context**

Notation of Temporal Structures

- Specialized Notations
    - Simply Numbers: Cue Lists
    - Spatial Notations, *("Streckennotation")*
- (General) Music Notation

    ➕ well elaborated, centuries of optimization

    ➕ compact

    ➕ easy readable, "one glance" (for musicians !-)

    ➕ utmost versatile and adaptable
       (covers MONTEVERDI to STOCKHAUSEN)

    ➖ specialized, restricted range (pitch information)

    ➖ restricted domain (metrical duration values)

    ➖ diversity of variants, partly conflicting (e.g. enharmonics)

    ➕ used in many "foreign" fields (alternative ranges)

markuslepper.eu

tScore — **Context**

Notation of Temporal Structures

- **Specialized Notations**
  - – Simply Numbers: Cue Lists
  - – Spatial Notations, *("Streckennotation")*
- (General) Music Notation

  ➕ well elaborated, centuries of optimization

  ➕ compact

  ➕ easy readable, "one glance" (for musicians !-)

  ➕ utmost versatile and adaptable
  (covers MONTEVERDI to STOCKHAUSEN)

  ➖ specialized, restricted range (pitch information)

  ➖ restricted domain (metrical duration values)

  ➖ diversity of variants, partly conflicting (e.g. enharmonics)

  ➕ used in many "foreign" fields (alternative ranges)

markuslepper.eu

tScore — **Context**

Notation of Temporal Structures

- Specialized Notations
    - – Simply Numbers: Cue Lists
    - – Spatial Notations, *("Streckennotation")*
- (General) Music Notation

    ➕ well elaborated, centuries of optimization

    ➕ compact

    ➕ easy readable, "one glance" (for musicians !-)

    ➕ utmost versatile and adaptable
       (covers MONTEVERDI to STOCKHAUSEN)

    ➖ specialized, restricted range (pitch information)

    ➖ restricted domain (metrical duration values)

    ➖ diversity of variants, partly conflicting (e.g. enharmonics)

    ➕ used in many "foreign" fields (alternative ranges)

    ➖ hardly computer compatible

markuslepper.eu

tScore — **Context**

Notation of Temporal Structures

- Specialized Notations
    - Simply Numbers: Cue Lists
    - Spatial Notations, *("Streckennotation")*
- (General) Music Notation

    ➕ well elaborated, centuries of optimization

    ➕ compact

    ➕ easy readable, "one glance" (for musicians !-)

    ➕ utmost versatile and adaptable
       (covers MONTEVERDI to STOCKHAUSEN)

    ➖ specialized, restricted range (pitch information)

    ➖ restricted domain (metrical duration values)

    ➖ diversity of variants, partly conflicting (e.g. enharmonics)

    ➕ used in many "foreign" fields (alternative ranges)

markuslepper.eu

tScore — **Context**

Notation of Temporal Structures

- Specialized Notations
    - – Simply Numbers: Cue Lists
    - – Spatial Notations, *("Streckennotation")*
- (General) Music Notation

    ➕ well elaborated, centuries of optimization

    ➕ compact

    ➕ easy readable, "one glance" (for musicians !-)

    ➕ utmost versatile and adaptable
    (covers MONTEVERDI to STOCKHAUSEN)

    ➖ specialized, restricted range (pitch information)

    ➖ restricted domain (metrical duration values)

    ➖ diversity of variants, partly conflicting (e.g. enharmonics)

    ➕ used in many "foreign" fields (alternative ranges)

    ➖ hardly computer compatible

tScore **Design Principles**

- Keep Principles of Conventional Music Notation
    - time flows from left to right
    - time distribution by division of space
    - synchronicity by super-position / vertical alignment
    - multiple tracks / parameters

- Do NOT keep restrictions

    - do NOT keep idiosyncratic junctims
    - (e.g duration by note head AND stem AND flags AND dots
    - AND ties AND tuplet brackets)

    - do NOT decide for certain parameter ranges (This is already
    - impossible in "pure" music !-)

    - do NOT decide for a certain domain structure
    - (there is NO standard notion of "time" !!)

    - allow arbitrary tracks with arbitrary parameter range
    - esp. allow *overloading*

    - make it *(typewriter) TEXT*

markuslepper.eu

tScore **Design Principles**

- Keep Principles of Conventional Music Notation
    - time flows from left to right
    - time distribution by division of space
    - synchronicity by super-position / vertical alignment
    - multiple tracks / parameters
- Do NOT keep restrictions
    - do NOT keep idiosyncratic junctims
      (e.g duration by note head AND stem AND flags AND dots
      AND ties AND tuplet brackets)
    - do NOT decide for certain parameter ranges (This is already
      impossible in "pure" music !-)
    - do NOT decide for a certain domain structure
      (there is NO standard notion of "time" !!)
    - allow arbitrary tracks with arbitrary parameter range
      esp. allow *overloading*
    - make it a *(typewriter) TEXT*

markuslepper.eu

tScore **Design Principles**

- Keep Principles of Conventional Music Notation
  - time flows from left to right
  - time distribution by division of space
  - synchronicity by super-position / vertical alignment
  - multiple tracks / parameters

- Do NOT keep restrictions
  - do NOT keep idiosyncratic junctims
    (e.g duration by note head AND stem AND flags AND dots
    AND ties AND tuplet brackets)
  - do NOT decide for certain parameter ranges (This is already
    impossible in "pure" music !-)
  - do NOT decide for a certain domain structure
    (there is NO standard notion of "time" !!)
  - allow arbitrary tracks with arbitrary parameter range
    esp. allow *overloading*
  - make it a *(typewriter) TEXT*

markuslepper.eu

tScore **Design Principles**

- Keep Principles of Conventional Music Notation
    - time flows from left to right
    - time distribution by division of space
    - synchronicity by super-position / vertical alignment
    - multiple tracks / parameters
- Do NOT keep restrictions
    - do NOT keep idiosyncratic junctims
      (e.g duration by note head AND stem AND flags AND dots
      AND ties AND tuplet brackets)
    - do NOT decide for certain parameter ranges (This is already
      impossible in "pure" music !-)
    - do NOT decide for a certain domain structure
      (there is NO standard notion of "time" !!)
    - allow arbitrary tracks with arbitrary parameter range
      esp. allow *overloading*
    - make it a *(typewriter) TEXT*

tScore **example with standard CWN data**

"PARS" separates independent time realms.

PARS prima
```
  T           19              !           !           20
```

```
  T           20                                      21
```

PARS seconda ....
EOF markuslepper.eu

tScore **example with standard CWN data**

"T" lines define flow of time.

```
PARS prima
  T            19              !            !            20



  T            20                                       21



PARS seconda ...
EOF
```
markuslepper.eu

tScore **example with standard CWN data**

T line entries define division of time.

PARS prima

T	19	!	!	20

T	20			21
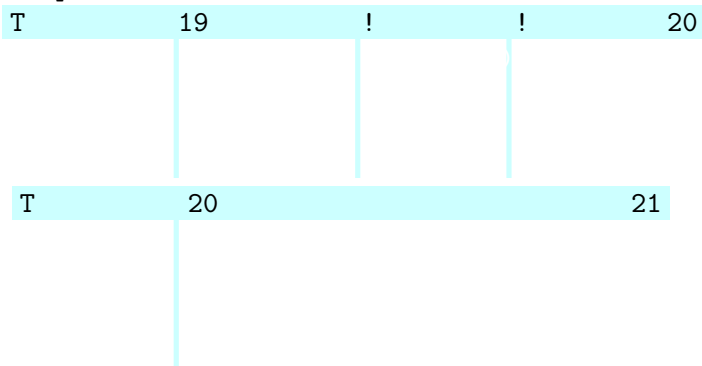
markuslepper.eu

tScore **example with standard CWN data**

"VOX" main parameter values define **events**

```
PARS prima
  T           19              !        !        20
     VOX sop  a     b         c     (d e)f (g a h)



  T           20                              21
     VOX sop  a           b       (e  f)




```
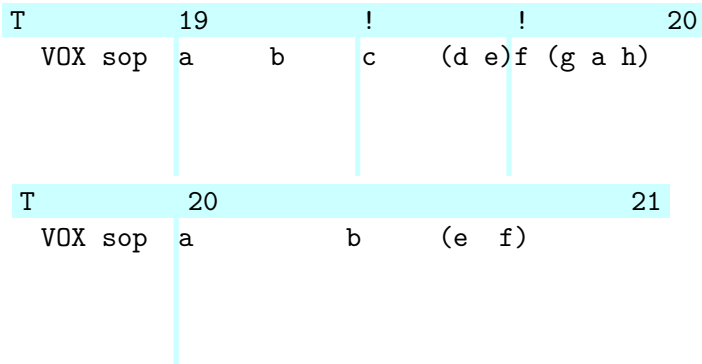
markuslepper.eu

tScore example with standard CWN data

. . . and thus further division of time.
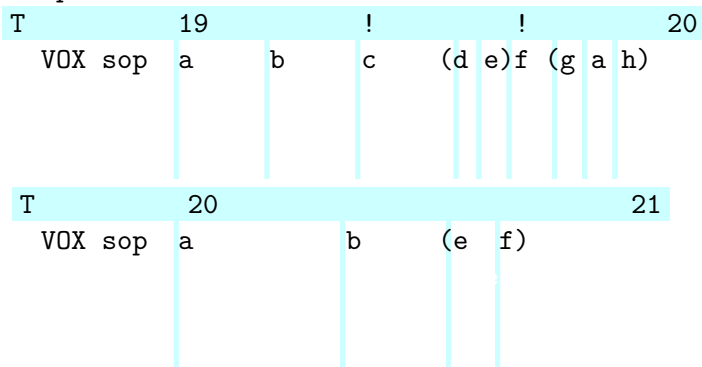
tScore example with standard CWN data

"P" parameter tracks for further specification of event data.

```
PARS prima
  T            19            !            !            20
    VOX sop  a       b       c    (d e)f (g a h)
      P dyn  f               ff<        >       pp
      P art  -       -       >          >       >

  T            20                              21
    VOX sop  a            b    (e  f)
      P nota [            !     clef-vl
                                ]
      P art  (                  ).-
```

markuslepper.eu

tScore **example with standard CWN data**

"P" parameter tracks separate lexical appearance and meaning.

```
PARS prima
  T              19              !              !              20
     VOX sop   a       b       c      (d e)f  (g a h)
        P dyn  f               ff<         >           pp
        P art  –       –       >           >           >


  T              20                           21
     VOX sop   a               b      (e  f)
        P nota [               !      clef-vl
                                      ]
        P art  (                      ).-
```

markuslepper.eu

tScore example with standard CWN data

Re-usage ("overloading") of lexical entities easily possible.

```
PARS prima
  T              19              !              !              20
    VOX sop   a       b       c       (d e f) (g a h)
       P dyn  f              ff<            >          pp
       P art  -       -       >              >          >


  T              20                                     21
    VOX sop   a              b       (e   f)
       P nota [              !          clef-vl
                                        ]
       P art  (                        ).-
```

markuslepper.eu

tScore **example with standard CWN data**

Re-usage ("overloading") of lexical entities easily possible.
(Almost) arbitrary "ASCII ART" permitted.

```
PARS prima
  T              19              !           !              20
    VOX sop   a        b         c      (d e)f) (g a h)
      P dyn   (f)               ff<         (>)        pp
      P art   -        -         >          (>)        >


  T              20                                    21
    VOX sop   a                 b      ((e   f)
      P nota  [                 !          clef-vl
                                              ]

      P art   (()                          ().-
```

markuslepper.eu

tScore, **Generic Building Blocks**

totally generic:

- Dotted Notation Expander
- Tendency / Group Collector
- Pattern Distributor
- Alternatives Combinator
- Placeholder Eraser
- *etc. . . .*

(more or less) specific for music / CWN:

- Running Octave Collector
- Metric Distributor
- *etc. . . .*

markuslepper.eu

tScore **Tendency and Group Collector**

```
T            19              !               !            20
  VOX sop  a        b      (c  d)   e      f      g
    P dyn  p<>1! >1!      >1  !1  >1!   ff0
```

markuslepper.eu

tScore **Tendency and Group Collector**

```
T              19              !              !              20
   VOX sop  a       b     (c  d)  e      f      g
     P dyn  p<>1! >1!      >1 !1  >1!   ff0
```


markuslepper.eu

tScore **Tendency and Group Collector**

```
T               19              !               !               20
   VOX sop  a       b       (c  d)  e       f       g
      P dyn  p<                              ff
             >1!     >1!         >1 !1  >1!
```
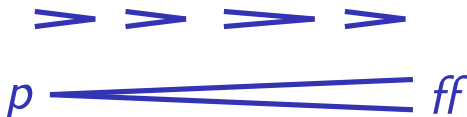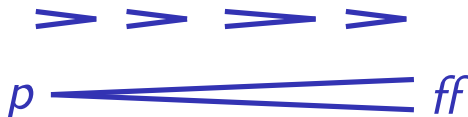

markuslepper.eu

tScore **Pattern Distributor**

```
T           19              !              !       !                        20
   VOX sop  a  b  c  d  b  c  d  e  %           c  d  e  f
      P art  $- .- (  )- sim              TERM      sim

      P ls   $f p  p  sim                  TERM      cont
```

markuslepper.eu

tScore **Pattern Distributor**

```
 T           19               !                !          !                20
   VOX sop  a  b  c  d  b  c  d  e  %          c  d  e  f
     P art  $-  .- (  )- sim              TERM    sim
     P art  -  .- (  )- -  .- (  )-                -  .- (  )-
     P ls   $f  p  p  sim              TERM    cont
```

markuslepper.eu

tScore **Pattern Distributor**

```
T           19              !              !       !              20
  VOX sop   a  b  c  d  b  c  d  e  %          c  d  e  f
    P art   $-  .- (   )- sim           TERM    sim
    P art   -   .- (   )- -   .- (   )-          -   .- (   )-
    P ls    $f  p  p  sim            TERM       cont
    P ls    f   p  p   f  p  p  f  p            p   f  p  p
```

markuslepper.eu

tScore **and lilypond DEMONSTRATION**

markuslepper.eu

Call for propositions !-)

We are interested in ideas for application and/or co-operation

- in music analysis or music performance.
- outside of music (dance? drama?)
- as an output medium, e.g. computer generated.
- (any other idea ?-)

```
http://www.bandm.eu/music
post@markuslepper.eu
baltasar@trancon.de
```

markuslepper.eu