Visualization and edition of polymers with non linear structures

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Outline

- Tool design for nonribosomal peptides
  - Extensible to any complex polymer
- Context
  - What are nonribosomal peptides?
- Structure representations
- Tools
- Conclusion and future work
What are nonribosomal peptides?

- > 500 monomers (amino acids and others)
- Complex 2D structures (linear, cycles, branches)
- 5 main specificities for NRPs
- Synthesized by bacteria and fungi
- Various activities (antibiotic, siderophore...)
- Synthesized by huge enzymatic complexes
What are nonribosomal peptides?

> 20 amino acids
fatty acids
carbohydrates
polyketides
chromophores

Monomers
What are nonribosomomal peptides?

Various 2D structures, mainly non linear

- branched
- double cyclic
- cyclic
- partial cyclic
- linear
- other

- bacillibactin
- vancomycin
- actinomycin D
- ACV

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Specific needs for interesting peptides

Biological interest: unusual peptides

Computer science interest: need for specific algorithms

no existing tools

http://bioinfo.lifl.fr/norine/

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Norine: 4 structure representations

Monomeric structure

Atomic structure

Textual representation for both structures

D-Pro, Ala, D-Ala, C10:0-NH2(2)-Ep(9)-oxo(8)@1,3@0,2@1,3@0,2
CC2NC(=O)C(C)NC(=O)C3CCCN3(C(=O)C(CCCCCC(=O)C1CO1)NC2(=O))
smiles2monomers

From the chemical structure to the monomeric structure
Monomeric editor
Monomeric visualisation

Algorithm for graph drawing
Specific strategies for simple structures
Conclusion and future work

- Visualization and edition of any polymers
- Source code available
  - used in Norine
- Extension to edition of atomic structures drawn with monomers
- Interaction with HELM notation + Pistoia Alliance
  Public resources or BIRD (PDB peptides)
What are nonribosomal peptides?

Various activities, several activities for some peptides

- Antibiotics: 642 NRPs
- Toxins: 263 NRPs
- Siderophores: 90 NRPs
- Protease inhibitors: 39 NRPs
- Anti-tumors: 101 NRPs
What are nonribosomal peptides?

Diverse industrial applications

Remediation of soils contaminated with toxic metals

Antibiotic
Avoid transplantation rejection
Anti-tumor

Plant protection against pathogens
NRP synthesis: high specificity

ACV synthetase

module 1 module 2 module 3

A C A C A T E Te

O\text{O}\text{O}
\text{O}
\text{O}

AAd_Cys_D-Val

penicillin

a given nonribosomal peptide synthetase

a specific nonribosomal peptide