

**LABO - Axe et Equipe :**

**LIMOS, Axe MAAD, Combinatorial Optimization**

**Thesis supervisor: First name Last name (position), email**

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**Title of PhD subject:**

**Combinatorics behind routing and spectrum assignment in modern optical telecom networks**

**Summary:**

*While developing solution methods for routing and spectrum assignment (RSA) in the ANR project FlexOPTIM (2018-20), see [1,3], we noticed that the problem can be interpreted in combinatorial terms as interval coloring in the conflict graphs of the routes [4], and that relying on such properties can substantially improve the solution methods [2].*

*The continuous growth of communication demands will soon lead to capacity bottlenecks in optical networks. Multiband scenarios will occur in the future and lead to even more complex models and solution approaches as currently studied within the EMBRACE project on multiband RSA (2021-24). As opening a new spectral band for operational use causes costs for installing the needed technical devices, it is important for network operators to stepwise define suitable subnetworks for this opening.*

*Our aim is to generalize previous studies from [2,4] to this more general setting, by investigating subnetworks that do neither cause unnecessarily long routes nor bottlenecks for the spectrum assignment due to substructures in the conflict graphs of the routes that cause difficulties for the interval colorings. For that, the study of edge intersection graphs of the routes and their non-superperfection are indispensable, depending on the embeddings of the routes in subnetworks of different types (notably  $k$ -trees for small values of  $k$ ).*

[1] R. Colares, H. Kerivin, and A. Wagler. 2022. An Extended Formulation for the Constrained Routing and Spectrum Assignment Problem in Elastic Optical Networks. In Joint ALIO/EURO International Conference 2021-2022 on Applied Combinatorial Optimization. 5–10.

[2] P. H. Fernandes da Silva, H. Kerivin, J. P. Nant, and A. Wagler. 2022. Solving the routing and spectrum assignment problem, driven by combinatorial properties. Networks 2023, 1-18.

[3] Y. Hadhbi, H. Kerivin, and A. Wagler. 2019. A novel integer linear programming model for routing and spectrum assignment in optical networks. In 2019 Federated Conference on Computer Science and Information Systems (FedCSIS). IEEE, 127–134.

[4] H. Kerivin and A. Wagler. 2020. On superperfection of edge intersection graphs of paths. In Graphs and Combinatorial Optimization: from Theory to Applications, C. Gentile et al. (Ed.). AIRO Springer Series 5, 79–91.

**Student:**

Victoria Kaial, previously enrolled in the Mathematics degree program at UN Rosario (Argentina) and the Master International Computer Science at UCA, best student in both degree programs, selected as participant of the 2023 edition of the Heidelberg Laureat Forum

**Future impact:**

Besides insights in combinatorial properties behind a challenging problem being important for our modern information society, we expect also a future impact to strengthen the relations of the two universities with to goal to establish a continuous exchange of students and research collaborations.