

# A Knowledge-Based System for DC Railway Electrification Verification

Eugenio Roanes-Lozano

Instituto de Matemática Interdisciplinar & Depto. de Álgebra, Geometría y Topología,  
Universidad Complutense de Madrid, Spain  
eroanes@mat.ucm.es

Rubén González-Martín

Ineco, Madrid, Spain & Universidad Politécnica de Madrid, Madrid, Spain  
rgonzalez.martin@ineco.com

Javier Montero

Instituto de Matemática Interdisciplinar & Departamento de Estadística e Investigación  
Operativa, Universidad Complutense de Madrid, Spain  
monty@mat.ucm.es

## Abstract

Gröbner bases can be used to verify knowledge-based systems (KBS) [1]. An algebraic approach can also be used to decide whether a given undirected graph can be 3-colored or not. We applied a related approach to decide whether a situation proposed to a railway interlocking system is safe or not [2]. The code of these algebraic approaches is really brief. We also implemented a matrix-based computer tool that allows an expert to automatically check whether a proposed scenario, given through the topology of the railway station and the positioning of the section insulators, air-gap insulators, earthing disconnectors, load disconnectors and remote load disconnectors, fulfills the requirements of the Spanish railway infrastructure administrator (ADIF) for 3,000 V railway electrifications or not [3] (testing if certain different states of these elements result in certain sections under electric tension or not). Now we have designed an implemented a new computer tool for this latter goal based on an algebraic translation of the problem. Unlike in [2], determining the sections under electric tension is computed solving linear systems (the graph is undirected), and therefore far bigger station layouts can be addressed.

The second author works in a railway electrification company and this work addresses a real world need, nowadays manually checked by experts, as KBS were verified in the past.

## References

1. E. ROANES-LOZANO AND L. M. LAITA AND A. HERNANDO. An Algebraic Approach to Rule Based Expert System. RACSAM Rev. R. Acad. Cien. Serie A. Mat. 104/1 (2010) 19-40. doi: 10.5052/RACSAM.2010.04.
2. E. ROANES-LOZANO AND E. ROANES-MACÍAS AND L. M. LAITA. Railway Interlocking Systems and Groebner Bases. Math. Comp. Simul. 51/5 (2000) 473-481. doi: 10.1016/S0378-4754(99)00137-8.
3. E. ROANES-LOZANO AND R. GONZÁLEZ-MARTÍN. Matrix Approach to DC Railway Electrification Verification. Proc. Comp. Sci. 108 (2017) 1424-1433. doi: 10.1016/j.procs.2017.05.226.