

---

# SANTIAGO NUMÉRICO I

Cuarto Encuentro de Análisis Numérico de Ecuaciones Diferenciales Parciales

Facultad de Matemáticas, Pontificia Universidad Católica de Chile, Enero 14 - 16, 2009

---

## BEM–FEM coupling: back to the beginning\*

FRANCISCO–JAVIER SAYAS <sup>†</sup>

### Abstract

The first coupled method of finite and boundary elements originated in the late seventies and has been commonly referred to as the Johnson–Nédélec, one–equation or unsymmetric coupling. Its main drawback, as originally perceived, was the need for a particular boundary integral operator to be compact. This fact demanded smooth enough coupling interfaces (which was a clear inconvenience from the FEM point of view) and precluded its use for linear elasticity.

Although it was not recognized at the time, the problem was purely theoretical in nature. We prove here that by recasting the discrete equations as a non–standard transmission problem, the lost ellipticity is recovered and that Johnson–Nédélec’s coupling is stable for any pair of discrete BEM–FEM spaces.

### References

- [1] JOHNSON, AND NÉDÉLEC, J.C., *On the coupling of boundary integral and finite element methods*. Mathematics of Computation, vol 35, pp. 1063-1079 (1980).
- [2] SAYAS, F.J., *The validity of Johnson–Nédélec’s BEM–FEM coupling on polygonal interfaces*. SIAM Journal on Numerical Analysis, in revision.

---

\*Research partially funded by MEC/FEDER Project MTM2007–63204 and Gobierno de Aragón (Grupo PDIE). This work was developed while the author was at the University of Minnesota supported by a Spanish MEC grant PR2007–0016.

<sup>†</sup>Dep. Matemática Aplicada, Universidad de Zaragoza (Spain) & School of Mathematics, University of Minnesota (USA), e–mail: [sayas002@umn.edu](mailto:sayas002@umn.edu)