Mathematical modeling and numerical simulation of gas flow through a one-way valve

Andrea Corli[1], **Ulrich Razafison**[2], **Massimiliano D. Rosini**[3]

SUMMARY

We consider an isothermal flow through two pipes; at the junction, the flow is modified by some devices, for instance a valve. We first provide a general framework to model the coupling conditions for the flow at both sides of the junction. A key feature in the modeling is the *coherence*; it is related to the chattering, i.e., the rapid switch on and off of a valve, which in turn is linked to the stability of the numerical schemes to approximate the solutions. We discuss the coherence of some models and present numerical simulations showing the chattering. We present an example of a modified model that is able to remove the chattering.

Keywords: Systems of conservation laws, gas flow, valve, Riemann problem, coupling conditions, chattering

AMS Classification: 35L65, 35L67, 76B75

References

[1] M. K. Banda, M. Herty and A. Klar. Coupling conditions for gas networks governed by the isothermal Euler equations *Netw. Heterog. Media* **1**, 295-314, 2006.

[2] A. Corli, M. D. Rosini. Coherence and chattering of a one-way valve. *ZAMM Z. Angew. Math. Mech.* **99**(6), e201800250, 25 pp., 2019.

[3] A. Corli, U. Razafison and M. D. Rosini. Coherence and flow maximization of a one-way valve. *ESAIM Math. Model Numer. Anal.* **56**(5), 1715–1739, 2022.

[1]Department of Mathematics and Computer Science,
University of Ferrara, Italy
email: `crl@unife.it`

[2]Laboratoire de mathmatiques de Besanon
Universit de Franche-Comt, France
email: `ulrich.razafison@univ-fcomte.fr`

[3]Department of Business Administration
University of Chieti-Pescara, Italy
email: `massimiliano.rosini@unich.it`