TITLE

Transmission channel control in WiNoC (Wireless Network-on-Chip) and SiP (System in Package) circuits using the reverberation chamber concept

LAB & PEOPLE

- **Name of the hosting lab:** Lab-STICC/UBO UMR 6285, MATRF department, DH team.
  General activities of the lab: DH team: Microwave Devices for telecommunications systems, sensor systems and radar imaging.
  Website: https://labsticc.fr/en/teams/dh
  Number of staff / PhD: DH team : 26 permanent members (Professors, Assistant Professors, Engineers and Technicians), 6 Postdoctoral researchers, 12 PhD.
- Supervisor name and contact: Pierre-Marie MARTIN (pierre-marie.martin@univ-brest.fr) and Thierry LE GOUGUEC (thierry.legouguec@univ-brest.fr)

TOPIC OF THE INTERSHIP

- **Scientific context of the internship (max 20 lines)**

Developments in electronics and microelectronics are resulting in more functionality per mm^2, higher data rates, reconfigurable systems and lower power consumption. To meet these demands, concepts of networks-on-chip (NoC) and System-in-package (SiP) have emerged [1]. In addition, the increase in data rate, linked to an increase in the working frequencies (more than 60 GHz) of the circuits, leads to several undesirable effects on the propagated signals in conventional wireline interconnects, such as mismatches, crosstalk, additional delays or desynchronization [2]. In the context of NoC circuits, the implementation of wireless interconnections seems to be a promising solution [3].
The study will focus on the development and optimisation of new propagation channels in the NoC or WiNoC context in CMOS technology. The aim is to control transmission levels over wide bandwidths and to limit losses in the channel. For this purpose, we propose the research of new concepts and new channel structures based on reverberation chamber techniques [4] used in EMC (Electromagnetic Compatibility). Indeed, if the analysis of the boundaries effects ("air-silicon" for CMOS circuits) has already been developed during two previous research works [5][6], it is important to extend these studies and consider new approaches to increase the transmission levels.

Keywords

Electromagnetic wave propagation, CMOS technology, WiNoC (Wireless Network-on-Chip), SIP (System in Package), reverberation chamber.

Bibliography

[1] S. Abadal, C. Han, and J. M. Jornet, "Wave Propagation and Channel Modeling in Chip-Scale Wireless Communications: A Survey from Millimeter-Wave to Terahertz and Optics," IEEE Access, vol. 8, pp. 278–293, Dec 2019. doi: 10.1109/ACCESS.2019.2961849.

[2] A. Deutsch et al., 'When are transmission-line effects important for on-chip interconnections?', IEEE Trans. Microw. Theory Tech., vol. 45, no. 10, pp. 1836–1846, Oct. 1997. doi: 10.1109/22.641781.

[3] Y. Liu, V. Pano, D. Patron, K. Dandekar, and B. Taskin, 'Innovative propagation mechanism for inter-chip and intra-chip communication', in 2015 IEEE 16th Annual Wireless and Microwave Technology Conference (WAMICON), Apr. 2015, pp. 1–6. doi: 10.1109/WAMICON.2015.7120367.

[4] P. del Hougne, K. B. Yeo, P. Besnier, and M. Davy, "On-Demand Coherent Perfect Absorption in Complex Scattering Systems: Time Delay Divergence and Enhanced Sensitivity to Perturbations," Laser Photonics Rev., , vol. 15, no. 7, pp. 1–16, Sept. 2020. doi: 10.1002/lpor.202000471.

[5] I. El Masri, T. Le Gouguec, P.-M. Martin, R. Allanic, and C. Quendo, "Electromagnetic Characterization of the Intrachip Propagation Channel in Ka- and V-Bands," IEEE Transactions on Components, Packaging and Manufacturing Technology, vol. 9, no. 10, pp. 1931–1941, Oct. 2019. doi: 10.1109/TCPMT.2019.2930347.

[6] I. El Masri, T. Le Gouguec, P.-M. Martin, R. Allanic, and C. Quendo, "A CMOS-Compatible Solution for Propagation Channels on Silicon in the mm-Wave Band" in 2020 50th European Microwave Conference (EuMC), Utrecht, Pays-Bas, jan. 2021, pp 256-259. doi: 10.23919/EuMC48046.2021.9338135.

- **Tasks and duties entrusted to the student:**

1. Bibliographic review on CMOS wireless interconnects in WiNoC and SIP.
2. Bibliographic review on Mode-Stirred Reverberation Chamber.
3. Feasibility study on new solutions based on reverberation techniques to improve transmission levels in an on-chip propagation channel.
   The student will be able to use the electromagnetic and circuit simulation software available in the laboratory (HFSS, CST, ADS, ...).

- **Skills to be acquired or developed:**

1. Study of a microwave propagation channels in CMOS technology
2. Concept of reverberation chamber applied to on-chip micro-reverberation.

PROFILE OF THE DESIRED STUDENT

- Minimum level of study required: in 2nd Year of Master (1st year of Master fully validated)
- Field(s) of study: Electronics, Physics, Applied Mathematics
- Scientific skills: Electromagnetism, Microwave Technology, Microelectronics

Language skills required: English

2023-24 – doing a Master internship at UBO

THE INTERNSHIP ASSIGNMENT:

Desired duration of the internship (in months): 4 months
Desired Starting date of the mission: March 11, 2024
Indicative weekly schedule: *35h / week*
Remuneration: *600€/month, paid on national SEA-EU funds for a maximum of 5 months ; additional Erasmus grant could be asked to your own university.*

Internship agreement: *an internship agreement will be signed.*

To SEA-EU students:
If you're interested please send your CV and letter of motivation to the scientist in charge, email pierre-marie.martin@univ-brest.fr *before the 31 January 2024.*