

# OpenROAD Singleton Removal

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**Abstract**— OpenROAD is a widely-used open-source RTL-to-GDSII flow. Recently, it was discovered that removing the static usage across the OpenROAD codebase could enhance the design flow, particularly in eliminating the usage of `OpenRoad::openroad()`. This paper discusses the suggested solution, which replaces `OpenRoad::openroad()` with injected OpenRoad objects.

**Keywords**— OpenROAD Flow Scripts, RTL-to-GDSII flow, open-source tools, automated design, no-human-in-the-loop.

## I. INTRODUCTION (HEADING 1)

OpenROAD is an efficient RTL-to-GDSII flow that provides an end-to-end design implementation solution for the digital integrated circuit industry. It has been widely adopted by the semiconductor community due to its open-source nature and efficiency in the design flow. However, during the development process, it was discovered that the static usage across the OpenROAD codebase, specifically `OpenRoad::openroad()`, could potentially cause issues in the design flow. Therefore, this paper proposes a solution that replaces the static usage of `OpenRoad::openroad()` with injected OpenRoad objects.

## II. IMPROVEMENTS

The suggested improvement is to remove the usage of `OpenRoad::openroad()` across the OpenROAD codebase, specifically in the Design class. Instead, injected OpenRoad objects will be used to replace the static usage. The Design class constructor will be modified to include an additional parameter, `std::unique_ptr<OpenRoad> openroad`, which will be injected during runtime. In addition, the `readVerilog` function in the Design class will also be modified to use the injected OpenRoad object.

The before and after implementation of the Design class is illustrated below:

### Before:

```
Design::Design(Tech* tech) : tech_(tech)
{
}

void Design::readVerilog(const std::string& file_name)
{
    auto chip = tech_>getDB()->getChip();
    if (chip && chip->getBlock()) {
        getLogger()->error(utl::ORD, 36, "A block already exists in the db");
    }

    auto app = OpenRoad::openRoad();
    app->readVerilog(file_name.c_str());
}
```

### After:

```
Design::Design(Tech* tech, std::unique_ptr<OpenRoad> openroad) : tech_(tech), openroad_(openroad)
{
}

void Design::readVerilog(const std::string& file_name)
{
    auto chip = tech_>getDB()->getChip();
    if (chip && chip->getBlock()) {
        getLogger()->error(utl::ORD, 36, "A block already exists in the db");
    }

    openroad_>readVerilog(file_name.c_str());
}
```

## III. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the removal of the static usage across the OpenROAD codebase, specifically `OpenRoad::openroad()`, can enhance the design flow. The suggested solution, which replaces the static usage with injected OpenRoad objects, will be implemented in the Design class. The proposed improvement is expected to result in a thread-safe OpenRoad library. The transition will begin in the team's spare cycles, with the ultimate goal being to provide a more efficient and reliable design implementation solution for the semiconductor community.

## REFERENCES

- [1] G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," *Phil. Trans. Roy. Soc. London*, vol. A247, pp. 529–551, April 1955. (*references*)
- [2] J. Clerk Maxwell, *A Treatise on Electricity and Magnetism*, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
- [3] I. S. Jacobs and C. P. Bean, "Fine particles, thin films and exchange anisotropy," in *Magnetism*, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
- [4] K. Elissa, "Title of paper if known," unpublished.
- [5] R. Nicole, "Title of paper with only first word capitalized," *J. Name Stand. Abbrev.*, in press.
- [6] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," *IEEE Transl. J. Magn. Japan*, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetism Japan, p. 301, 1982].
- [7] M. Young, *The Technical Writer's Handbook*. Mill Valley, CA: University Science, 1989.

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