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Optimization of concentrated solar power system: Calculate the sensitivities by the method of MonteCarlo and its coupling with a method of Descente Gradient

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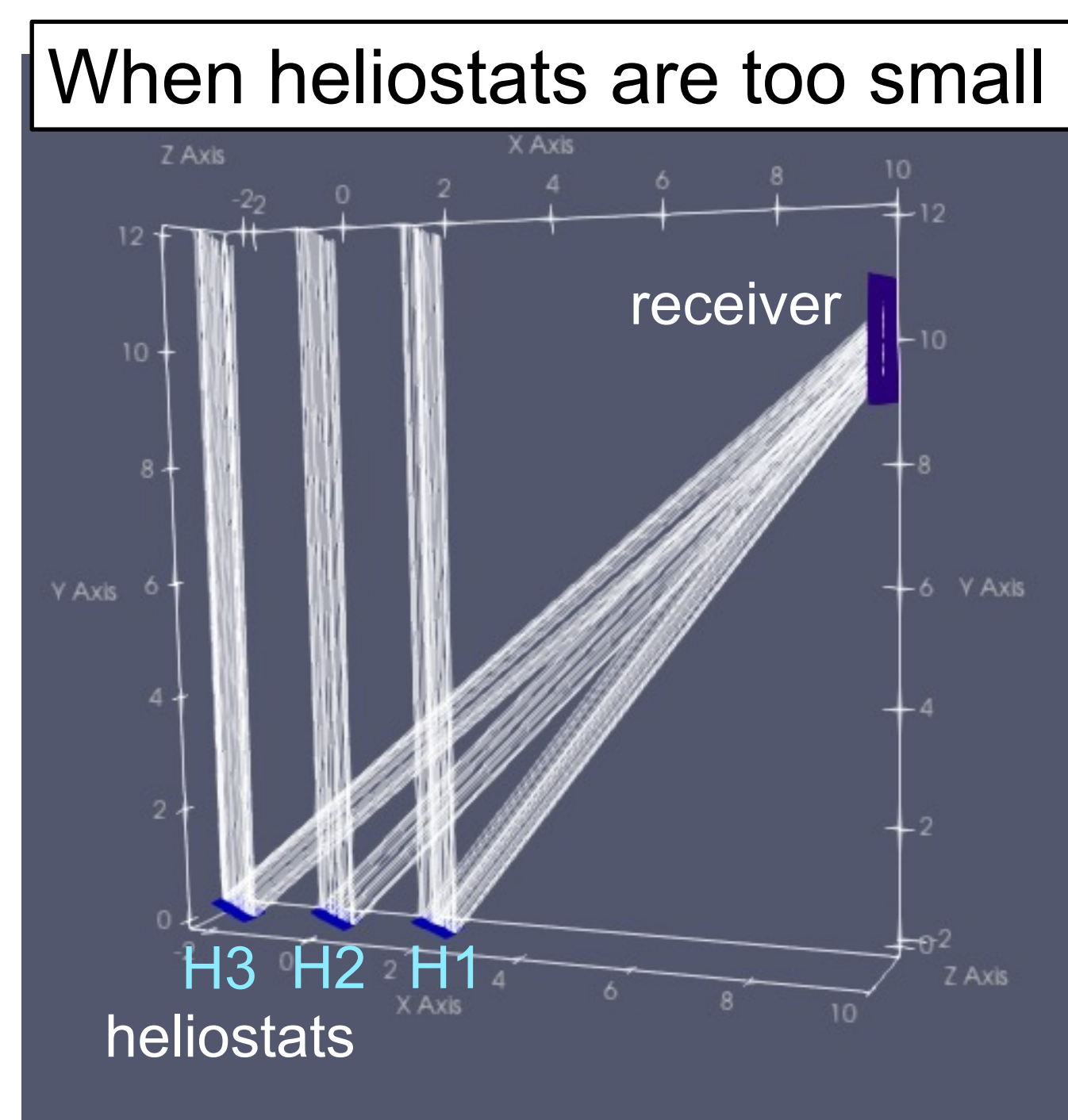
Optimization of concentrated solar power system: Calculate the sensitivities by the method of Monte- Carlo and its coupling with a method of Descente Gradient

RAPSODEE UMR CNRS 5302

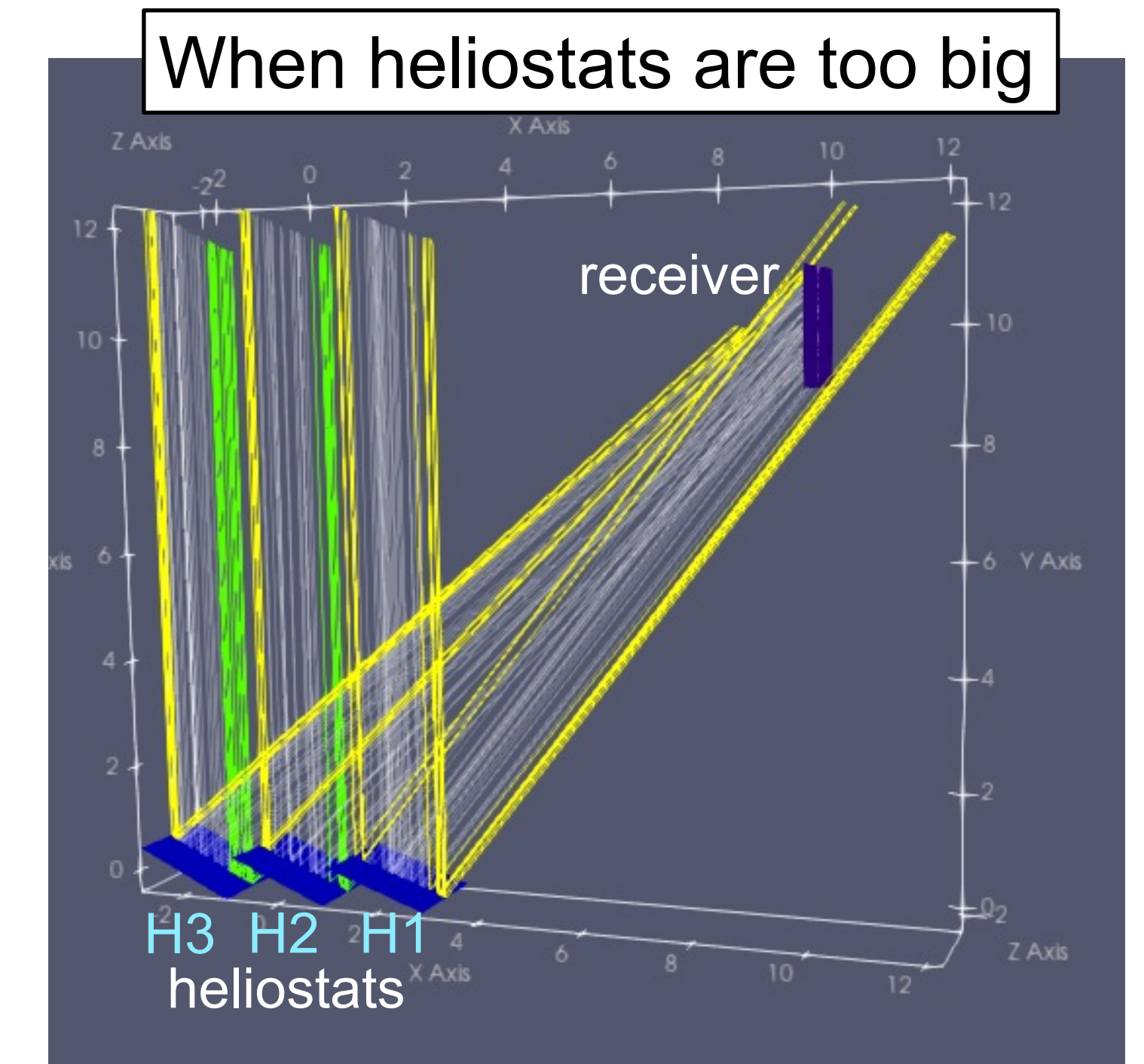
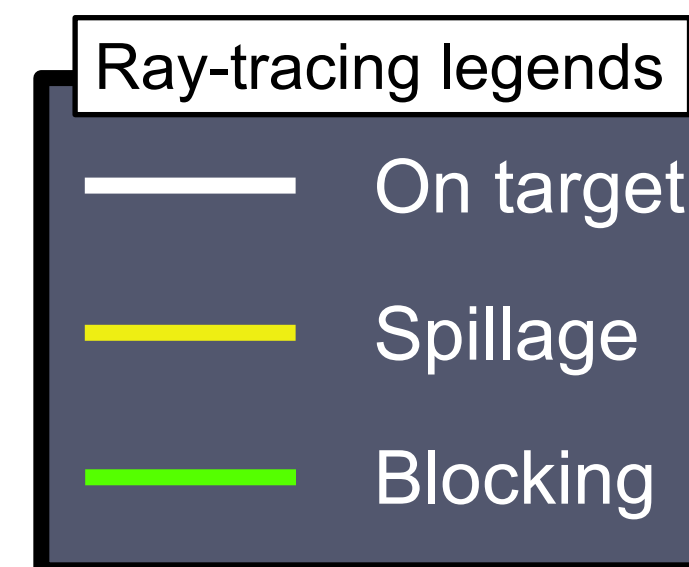
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Aims:

- Optimize the size of heliostats in a CSP system for a maximum received power



What is the best size for these heliostats?

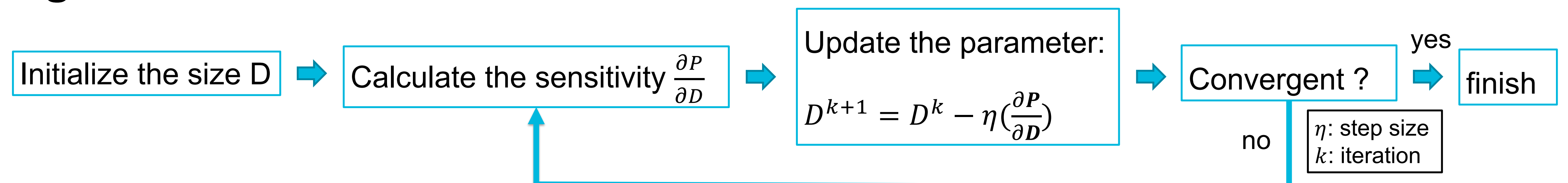


Methods:

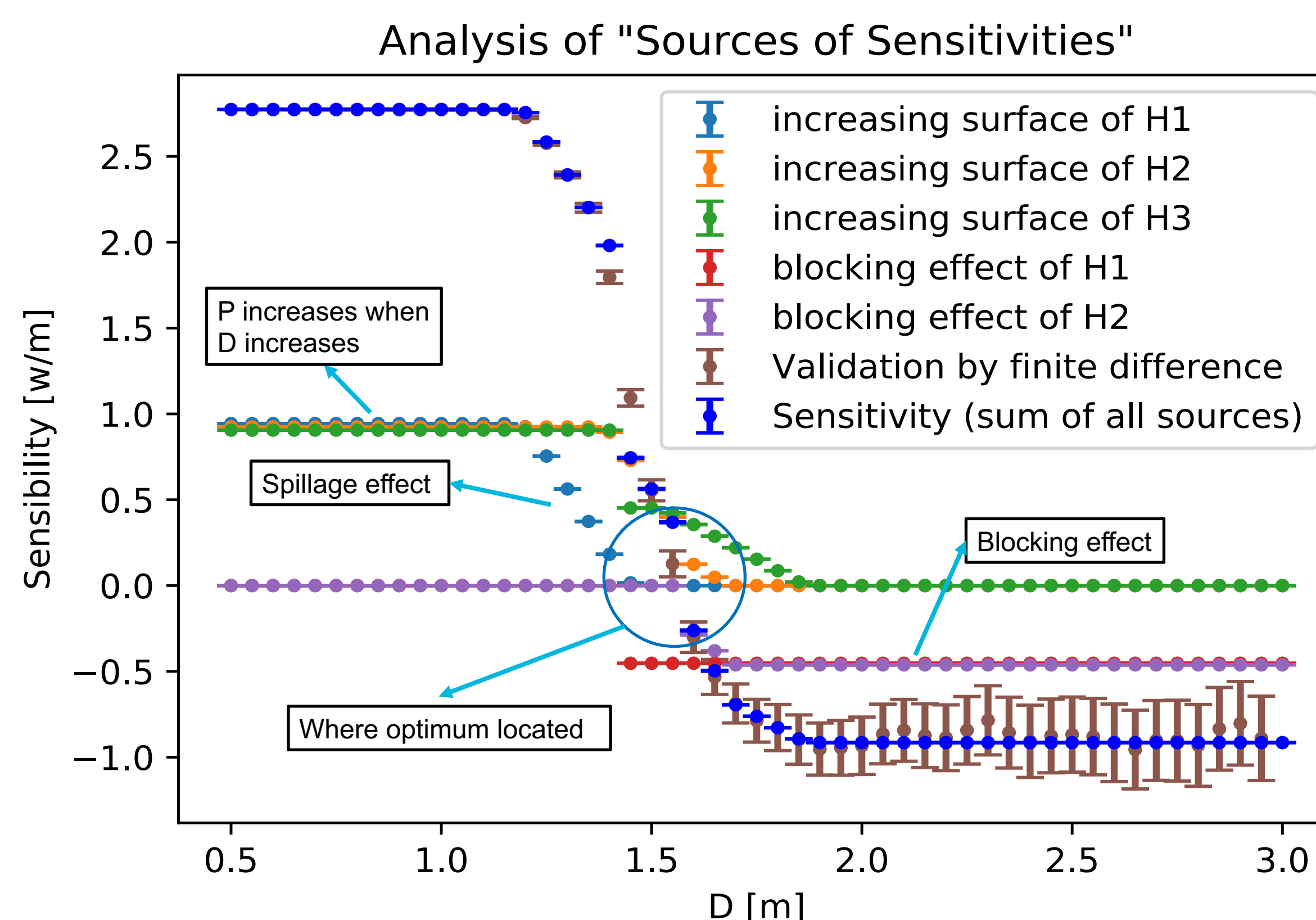
- Take the new approach (Sensitivity Transport Models for Domain Deformation [1]) to calculate the sensitivity $\frac{\partial P}{\partial D}$ by Monte-Carlo method [2]
- Optimize size of heliostats by gradient descent method

P [w]: arriving power on receiver
D [m]: size of heliostats

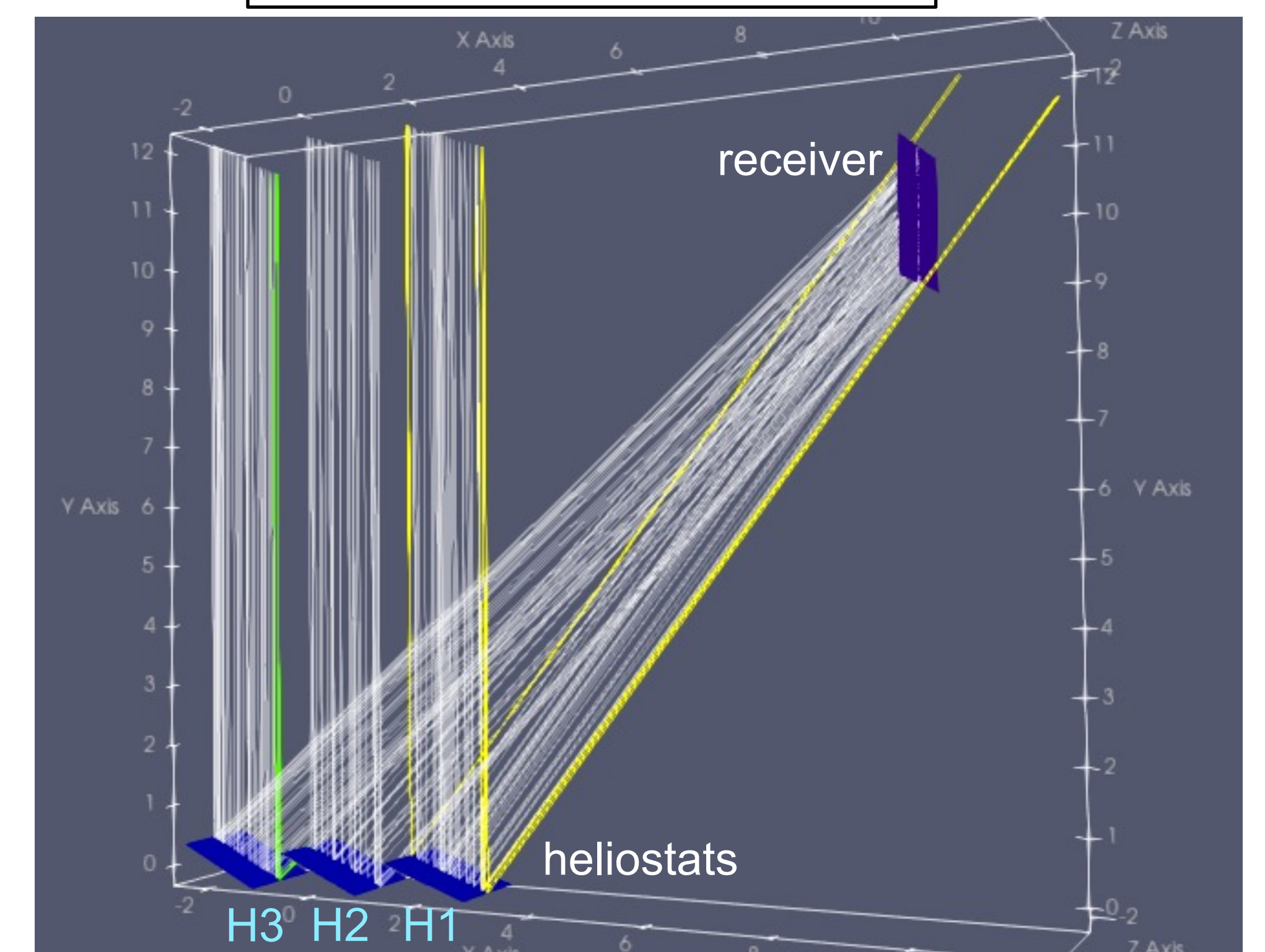
Algorithm:



Results:



Optimized heliostats size



Conclusion:

- The new approach of calculating geometrical sensitivity^{[1][2]} by Monte-Carlo method allows detailed analysis of blocking, spillage and shadowing effect in 2D with 3 heliostats
- Such approach is coupled with a method of gradient descent to optimize the sizes of heliostats for a maximum received power

Perspectives:

- Generalize the method for 3D configurations and for higher numbers of heliostats
- Optimize the position, pointing strategy and heliostat deformation in a CSP system

[1] Lapeyre, P., S. Blanco, C. Caliot, J. Dauchet, M. El Hafi, R. Fournier, O. Farges, J. Gautrais, and M. Roger. "Monte-Carlo and Sensitivity Transport Models for Domain Deformation." Journal of Quantitative Spectroscopy and Radiative Transfer 251 (August 1, 2020): 107022. <https://doi.org/10.1016/j.jqsrt.2020.107022>.
[2] Farges, Olivier. "Conception optimale de centrales solaires à concentration : application aux centrales à tour et aux installations 'beam down.'" Phdthesis, Ecole des Mines d'Albi-Carmaux, 2014. <https://tel.archives-ouvertes.fr/tel-01135529>.

Other institutes



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