Extreme Scale Search with ROCS X: Trillion-Scale Virtual Screening with Synthon-Driven 3D Search

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Summary:

- Trillion-scale 3D virtual screening made possible by unenumerated synthon-based search
- AI-guided search discover drug-candidates hits while evaluating only 0.0002% of chemical space
- ROCS X libraries contain billions of easily synthesizable compounds from well-defined reactions
- Practical applications include hit discovery beyond purchasable space, with multiple bound co-crystal structures confirmed

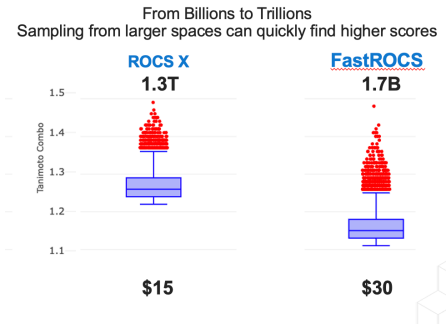
Product Keywords: Virtual Screening, ROCS®, FastROCS™, ROCS X™, Orion®

Abstract:

ROCS X™ enables virtual screening of compound libraries at the trillion-molecule scale, addressing the growing need to explore chemical space beyond commercially available catalogs. ROCS X constructs synthetically accessible virtual libraries using ~7.4 million purchasable building blocks and a curated set of chemical reactions. These libraries are stored in an unenumerated synthon-based architecture to maintain computational efficiency

Using ROCS X, Treeline Biosciences found 150+ novel, synthesizable compounds not available from purchaseable vendor libraries.

To navigate such vast spaces, ROCS X employs an AI-guided active learning strategy. The Bayesian Bandits approach prioritizes sampling of promising regions based on queries derived from known ligands and small molecules. Initial products are scored using FastROCS, and top hits are used to iteratively refine the search.



Based on the Tanimoto Combo score, ROCS X recovers over 90% of top hits while sampling 0.0002% of a 1.3-trillion-compound library.

ROCS X has demonstrated success across multiple industry drug-discovery projects. In one example, Treeline Biosciences' application of ROCS X yielded more than 150 synthesizable compounds not found in vendor catalogs. Several of these compounds have been experimentally validated through co-crystal structures bound to their targets.

ROCS X is available on the Orion molecular design cloud platform, enabling scalability and automation. Results generated by ROCS X can be readily integrated into downstream ligand- and structure-based workflows, such as docking and binding free energy calculations.

Source: OpenEye miniCUP Presentation, October 2025, Japan

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