

Testing, Simulating, and Profiling Designated Problems for CASL

Thermal-Hydraulic Sub-channel Code for Light Water Reactors Transient Analyses (COBRA-TF)

Simulation is an essential step for future implementations of more efficient and safer reactor components. In nuclear technology, this translates to cost reduction, fuel improvements, waste reduction, and safety enhancement. CASL's mission is to apply existing modeling and simulation capabilities and develop advanced capabilities to create a usable environment for predictive simulation of light water reactors.

Research objectives

Provide developers with useful information to aid program optimization

- Dynamic program analysis
- Code's performance and behavior
- Frequency and duration of function calls

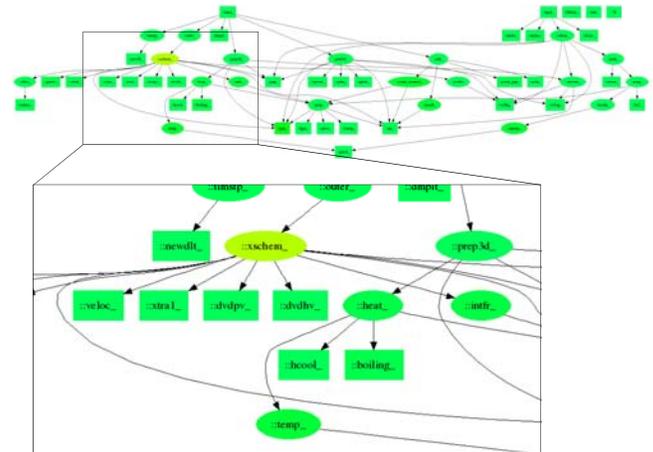


Figure 2. Call graph for better understanding of the COBRA-TF behavior

COBRA-TF behavior

- Test and simulate designated problems
- Profile code's behavior
- Collect, organize, analyze, and visualize results
- Provide feedback to developers



Figure 3. The Consortium for Advanced Simulation of Light Water Reactors (CASL) is the first DOE energy innovation hub; CASL is designed to bring together scientists and engineers from private and public institutions to achieve high-priority energy goals. <http://www.casl.gov>

Profile output					Description				
%	cumulative seconds	self seconds	calls	self s/calls	total s/calls	name	Description	Called by	Calls
45.48	765.52	765.52	1122	0.00	0.00	xschem_	linearizes the momentum, continuity and energy equations	outer	infr gssolv filtro vdrift tgas veloc sat dvdrh1 stral dvdrpv dvdrh
11.08	952.09	186.57	124634943	0.00	0.00	tgas_	Calculates vapor temperature and specific heat capacity cp of vapor	cobral prep3d xschem post3d prop	
6.59	1063.09	111	1122	0.00	0.00	result_channel_	Prints the sub-channel results of the calculation at specified time intervals	edit	prop sat
5.84	1161.36	98.27	45936	0.00	0.00	sstemp_	calculates the steady state temperatures for fuel rods	heatin	gauss
5.81	1259.22	97.86	1122	0.00	0.00	temp_	Calculates temperature at the new time step for fuel rods and unheated conductors	heat	gauss
4.23	1330.38	71.16	1122	0.00	0.00	result_	Prints solution results at specified intervals	edit	sat

Figure 1. Top seven time-consuming functions of COBRA-TF

The research showed that during this particular simulation, 56.56% of the time is being spent at two subroutines

- 45.48% of time spent at subroutine xschem
- 11.08% of time spent at subroutine tgas

The overall performance of the program can be greatly enhanced by implementing xschem and tgas routines.