Algorithm to Calculate Thermomechanical Solution Over an Interval $(t_n, t_{n+1}]$ Using a One-Way Coupling

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1 Description of the algorithm

Data: Configuration at time n, solution fields (T and $\mathbf{d}$) and history variables at time n, time step size Δt
Result: Configuration at time $n+1$, solution fields and history variables at time $n+1$

for $n := 1, 2, \ldots$ **do**
$T_{n+1}^{(1)} = T_n$
for $i := 1, n_{thermal}$ **do**
$T_{n+1}^{(i+1)} = T_{n+1}^{(i)}$
$\dot{T}_{n+1}^{(i+1)} = \left(T_{n+1}^{(i+1)} - T_n\right)/\Delta t$
Update element quantities and boundary conditions, based on latest configuration $\mathbf{x}_{n+1}$ and temperatures T_{n+1} and $\dot{T}_{n+1}$;
Calculate thermal residual;
Calculate temperature increment ΔT;
Update temperatures T_{n+1} and $\dot{T}_{n+1}$;
$T_{n+1}^{(i+1)} = T_{n+1}^{(i)} + \Delta T$
$\dot{T}_{n+1}^{(i+1)} = \left(T_{n+1}^{(i+1)} - T_n\right)/\Delta t$
Calculate thermal convergence data;
if *thermal converged* **then**
exit thermal solution loop;
end if
end for
$\mathbf{d}_{n+1}^{(1)} = \mathbf{d}_n$
for $i := 1, n_{solid}$ **do**
$\mathbf{d}_{n+1}^{(i+1)} = \mathbf{d}_{n+1}^{(i)}$
Update element quantities and boundary conditions, based on latest configuration $\mathbf{x}_{n+1}$ and temperatures T_{n+1};
Calculate solid mechanics residual;
Calculate displacement increment $\Delta \mathbf{u}$;
Update displacement $\mathbf{u}_{n+1}$ and configuration $\mathbf{x}_{n+1}$;
$\mathbf{d}_{n+1}^{(i+1)} = \mathbf{d}_{n+1}^{(i)} + \Delta \mathbf{u}$
Calculate solid mechanics convergence data;
if *solid mechanics converged* **then**

exit solid mechanics solution loop;

end if

end for

end for