BFO 2020 Occurrent Mereology Axioms

Occurrent part of and has occurrent part are inverse relations [yvi-1]

$\forall a,b\,(occurrentPartOf(a,b) \leftrightarrow hasOccurrentPart(b,a))$

Proper occurrent part of and has proper occurrent part are inverse relations [wim-1]

$\forall a,b\,(properOccurrentPartOf(a,b) \leftrightarrow hasProperOccurrentPart(b,a))$

Occurrent part of is reflexive [hbj-1]

$\forall a\,(\exists t\,instanceOf(a,occurrent,t) \rightarrow occurrentPartOf(a,a))$

Occurrent part of is antisymmetric [xlu-1]

$\forall a,b\,(occurrentPartOf(a,b) \wedge occurrentPartOf(b,a) \rightarrow a{=}b)$

A proper occurrent part of b means a is an occurrent part of b and a is not the same as b [okr-1]

$\forall x,y\,(properOccurrentPartOf(x,y) \leftrightarrow occurrentPartOf(x,y) \wedge x{\neq}y)$

Occurrent part of is transitive [kad-1]

$\forall a,b,c\,(occurrentPartOf(a,b) \wedge occurrentPartOf(b,c) \rightarrow occurrentPartOf(a,c))$

If one occurrent is part of another, then the temporal region on which the former projects is a part of the temporal region on which the latter projects [ybr-1]

$\forall o1,o2\,(occurrentPartOf(o1,o2) \rightarrow \forall t(existsAt(o1,t) \rightarrow existsAt(o2,t)))$

If a occurrent part of b then if a is an instance of temporal region then b is an instance of temporal region, and vice versa [gjl-2]

$\forall p,q\,(occurrentPartOf(p,q)$
$\qquad \rightarrow (instanceOf(p,temporalRegion,p) \leftrightarrow instanceOf(q,temporalRegion,q)))$

Occurrent part of has domain occurrent and range occurrent [zmr-1]

$\forall a,b\,(occurrentPartOf(a,b) \rightarrow \exists t\,instanceOf(a,occurrent,t) \wedge \exists t\,instanceOf(b,occurrent,t))$

If a occurrent part of b then if a is an instance of process then b is an instance of process [csk-1]

$\forall p,q\,(occurrentPartOf(p,q) \rightarrow (\exists t\,instanceOf(p,process,t) \rightarrow \exists t\,instanceOf(q,process,t)))$

Proper temporal part of has domain occurrent and range occurrent [ees-1]

$\forall a,b\,(properTemporalPartOf(a,b)$
$\qquad \rightarrow \exists t\,instanceOf(a,occurrent,t) \wedge \exists t\,instanceOf(b,occurrent,t))$

Proper occurrent part of has domain occurrent and range occurrent [yhc-1]

$\forall a,b\,(properOccurrentPartOf(a,b)$
$\qquad \rightarrow \exists t\,instanceOf(a,occurrent,t) \wedge \exists t\,instanceOf(b,occurrent,t))$

Every process has a process boundary [aff-1]

$\forall p\,(\exists t\,instanceOf(p,process,t)$
$\qquad \rightarrow \exists pb,t(instanceOf(pb,processBoundary,t) \wedge occurrentPartOf(pb,p)))$

Definition of temporal part for temporal regions [cmy-2]

$\forall b,c\,(instanceOf(b,temporalRegion,b) \wedge instanceOf(c,temporalRegion,c)$
$\qquad \rightarrow (temporalPartOf(b,c) \leftrightarrow occurrentPartOf(b,c)))$

If a has occurrent part b then if a is an instance of process boundary then b is an instance of process boundary [hdk-1]

$\forall p,q\,(hasOccurrentPart(p,q)$
$\qquad \rightarrow (\exists t\,instanceOf(p,processBoundary,t) \rightarrow \exists t\,instanceOf(q,processBoundary,t)))$

If a occurrent part of b then if a is an instance of spatiotemporal region then b is an instance of spatiotemporal region, and vice versa [myl-1]

$\forall p,q\,(occurrentPartOf(p,q)$
$\qquad \rightarrow (\exists t\,instanceOf(p,spatiotemporalRegion,t)$
$\qquad\quad \leftrightarrow \exists t\,instanceOf(q,spatiotemporalRegion,t)))$

If a has occurrent part b then if a is an instance of process then b is an instance of process or process boundary [ccz-1]

$\forall$p,q (hasOccurrentPart(p,q)
$\quad \rightarrow (\exists$t instanceOf(p,process,t)
$\quad\quad \rightarrow \exists$t(instanceOf(q,process,t)$\lor$instanceOf(q,processBoundary,t))))

If a occurrent part of b then if a is an instance of process boundary then b is an instance of process or process boundary [ptm-1]

$\forall$p,q (occurrentPartOf(p,q)
$\quad \rightarrow (\exists$t instanceOf(p,processBoundary,t)
$\quad\quad \rightarrow \exists$t(instanceOf(q,process,t)$\lor$instanceOf(q,processBoundary,t))))

A process boundary is any temporal part of a process that has no proper temporal parts. [esh-1]

$\forall$pb ($\exists$t instanceOf(pb,processBoundary,t)
$\quad \leftrightarrow (\exists$p(temporalPartOf(pb,p)$\land \exists$t instanceOf(p,process,t)))
$\quad\quad \land (\exists$t(occupiesTemporalRegion(pb,t)$\land$instanceOf(t,temporalInstant,t))))

Occurrent part of has a unique product [hpc-1]

$\forall$x,y ($\exists$t(instanceOf(x,occurrent,t)$\land$instanceOf(y,occurrent,t)
$\quad\quad \land$instanceOf(t,temporalRegion,t))
$\quad \rightarrow (\exists$w (occurrentPartOf(w,x)$\land$occurrentPartOf(w,y))
$\quad\quad \rightarrow \exists$z($\forall$w (occurrentPartOf(w,z) $\leftrightarrow$ occurrentPartOf(w,x)$\land$occurrentPartOf(w,y)))))

At least one process boundary needs to be at the first or last instant of the process it bounds [qsp-1]

$\forall$p ($\exists$tp instanceOf(p,process,tp)
$\quad \rightarrow \exists$pb,tb,tp (occupiesTemporalRegion(p,tp)$\land$occurrentPartOf(pb,p)
$\quad\quad\quad \land$occupiesTemporalRegion(pb,tb)$\land$instanceOf(pb,processBoundary,tb)
$\quad\quad\quad \land (\exists$ltp,ftp(hasFirstInstant(tp,ftp)$\land$hasLastInstant(tp,ltp)
$\quad\quad\quad\quad\quad \land$(tb=ftp$\lor$tb=ltp)))))

B temporal part c (both spatiotemporal regions) iff b temporal projection is part of c's temporal projection, and for all parts of b's existence, if it spatially projects onto s at that time, then so does c [eom-2]

$\forall$b,c ($\exists$t instanceOf(b,spatiotemporalRegion,t)$\land \exists$t instanceOf(c,spatiotemporalRegion,t)
$\quad \rightarrow$ (temporalPartOf(b,c)
$\quad\quad \leftrightarrow \exists$tb,tc (temporallyProjectsOnto(b,tb)$\land$temporallyProjectsOnto(c,tc)
$\quad\quad\quad \land$occurrentPartOf(tb,tc)
$\quad\quad\quad \land (\forall$tp (occurrentPartOf(tp,tb)$\land \exists$s spatiallyProjectsOnto(b,s,tp)
$\quad\quad\quad\quad \rightarrow \exists$s (spatiallyProjectsOnto(b,s,tp)
$\quad\quad\quad\quad\quad \land$spatiallyProjectsOnto(c,s,tp)))))))

Two spatiotemporal regions are parts when they are temporal parts and their spatial projects are always parts [txf-1]

$\forall$st1,st2 ($\exists$t instanceOf(st1,spatiotemporalRegion,t)
$\quad\quad \land \exists$t instanceOf(st2,spatiotemporalRegion,t)
$\quad \rightarrow$ (occurrentPartOf(st1,st2)
$\quad\quad \leftrightarrow (\exists$t1,t2 (temporallyProjectsOnto(st1,t1)$\land$temporallyProjectsOnto(st2,t2)
$\quad\quad\quad\quad \land$temporalPartOf(t1,t2)))
$\quad\quad \land (\forall$t(existsAt(st1,t)
$\quad\quad\quad \rightarrow \exists$s1,s2,tp(temporalPartOf(tp,t)$\land$spatiallyProjectsOnto(st1,s1,tp)
$\quad\quad\quad\quad \land$spatiallyProjectsOnto(st2,s2,tp)
$\quad\quad\quad\quad \land$continuantPartOf(s1,s2,tp))))))