$space$-
$time$
n
M
R^n
$p \in$
M
U
p
h
U
U'
R^n

$h : U \to U'.$
h
h
is
U
$h(p)$
spe-
M
cial-
h
$(x^1, \ldots, x^n)$
sa-
tion
h
of
M
R^n
a
M
map
$h_\alpha \circ$
φ^{-1}
h_β
from
$U_\alpha \cap$
one
$U_\beta \neq$
man-
0
R^n
fold
h_α
M_β
dif-
fer-
en-
$tiable$
dif-
man-
fer-
en-
$tiable$
man-
N
i
$fold$
h
M
$U \subset M$
N.
$U \subset$
R^n
$h :$
$D \to$
$U, p \mapsto$
$h(p) =$
$(x_1, \ldots, x_n), i.e.itassignsann-$
$tupelofcoordinates\{_i\}$
$p \in$
D
$(\theta, \varphi) \in S^2 \mapsto (\ s\ )\ in\theta cos\varphi sin\theta sin\varphi cos\theta \in R^3$

R^3
S^1
.
S^1
$\overline{0}$
2
(S^1)
$\overline{\overline{0}}$
$\overline{2}$
p
p
tan-
gen-
$tial$
$space$
T_pM
M
p
$\mathcal{F}(p)$
$\mathcal{F} :=$
$\{f \in$
$C^\infty | f :$
$M \to$
$R\}$
v
$\mathcal{F}(p)$
(R)