´o
ó
$D \subseteq$
$R^2$
á
$$\begin{cases} s = \varphi_1(t,x) \\ y = \varphi_2(t,x) \end{cases}$$
$\varphi_1, \varphi_2 D R(t,x) \varphi_1(t,x), \varphi_2(t,x) cambiartantolaexpresióndelaecuacióndiferencialcomoeldominioparafacilitarlaresoluci$
$R^2$
ó
$\hat{f}(s,y)$
ó
$\hat{f} D_1 R(s,y) \hat{f}(s,y) Yserádenuestrointerésbuscarlaexpresióndedicha \hat{f}$
é
$\varphi$
$\varphi$
$\psi =$
$\varphi^{-1}$
á
$\varphi$
$\psi$
$C^1$
á
é
ó
$y$
ó
$s$
ó
$r \in$
$N$
ó
$f :$
$A \to$
$B$
$C^r$
$f$
$C^r(A)$
$f^{-1}$
$C^r(B)$
á
$\varphi$
$C^1$
ó
1
ó
é
á
ó
á
ó
1
$$\begin{cases} s = \varphi_1(t,x) \\ y = \varphi_2(t,x) \end{cases}$$
$x =$
$x(t)$
ó
ó
$s$
$y$
ó
$t$
$$\begin{cases} s(t) = \varphi_1(t,x(t)) \\ y(t) = \varphi_2(t,x(t)) \end{cases}$$
$y$
ó
$y =$
$y(s)$
$\partial \varphi_2 \partial t(t,x) +$
$\partial \varphi_2 \partial x(t,x) x'(t) \partial \varphi_2 \partial t(t,x) +$
$\partial \varphi_2 \partial x(t,x) f(t,x)$
$(*)$
$x$
ó
ó
$\partial \varphi_1 \partial t(t,x) +$
$\partial \varphi_1 \partial x(t,x) f(t,x)$
í

---

Recordamos
que
una
función
de
$R^2$
sea
de
clase
$C^1$
sig-
nifica

$\partial\varphi_2\partial t(t,x)+$
$\partial\varphi_2\partial x(t,x)f(t,x)\partial\varphi_1\partial t(t,x)+\partial\varphi_1\partial x(t,x)f(t,x)$
í
ó
o
$s$
$y$
$t$
$x$
$t$
$x$
o
$\psi$
$\varphi(t,x)=$
$(s,y)\Longrightarrow$
$\psi(s,y)=$
$(t,x)$

$\partial\varphi_2\partial t(\psi(s,y))+$
$\partial\varphi_2\partial x(\psi(s,y))f(\psi(s,y))\partial\varphi_1\partial t(\psi(s,y))+\partial\varphi_1\partial x(\psi(s,y))f(\psi(s,y))$
ó
o
$\hat{f}(s,y)=$
$\partial\varphi_2\partial t(\psi(s,y))+\partial\varphi_2\partial x(\psi(s,y))f(\psi(s,y))\partial\varphi_1\partial t(\psi(s,y))+\partial\varphi_1\partial x(\psi(s,y))f(\psi(s,y))$
$\hat{f}(s,y)$

ó
2

4

ó

$$\frac{dy}{ds} = \hat{f}(s,y) \tag{3}$$

$\hat{f}(s,y) = \frac{\frac{\partial\varphi_2}{\partial t}(\psi(s,y)) + \frac{\partial\varphi_2}{\partial x}(\psi(s,y))f(\psi(s,y))}{\frac{\partial\varphi_1}{\partial t}(\psi(s,y)) + \frac{\partial\varphi_1}{\partial x}(\psi(s,y))f(\psi(s,y))} \forall (s,y) \in D_1$

$x = x(t)$

ó

ó??

$I \subseteq R$

$\begin{cases} s = \varphi_1(t,x(t)) \\ y = \varphi_2(t,x(t)) \end{cases}$

$\varphi_1(t,x(t))$ que es derivable por la regla de la cadena, con derivada distinta de 0:

$S'(t) = \frac{\partial\varphi_1}{\partial t}(t,x) + \frac{\partial\varphi_1}{\partial x}(t,x)x'(t) = \frac{\partial\varphi_1}{\partial t}(t,x) + \frac{\partial\varphi_1}{\partial x}(t,x)f(t,x) \neq 0 \forall t \in I$ ya que el cambio era admisible. Defino intervalo abierto, y podemos ahora aplicar el Teorema de la función inversa sobre, obten

$y J R s \varphi_2(T(s),x(T(s)))$ Nos falta derivar respecto a para comprobar que sea solución de la ecuación diferencial **??**: $y'(s) = \partial\varphi$

$\psi$

í

$\psi(s,y(s)) = (T(s),x(T(s)))$

$t$

$x$

ó

á

ó

$s$

$y$

$\left(\frac{\partial\varphi_2}{\partial t}(\psi(s,y(s))) + \frac{\partial\varphi_2}{\partial x}(\psi(s,y(s))) \cdot f(\psi(s,y(s)))\right)$

$T'(s)$

ó??

ó

ó

$\frac{\partial\varphi_1}{\partial t}(T(s),x(T(s))) + \frac{\partial\varphi_1}{\partial x}(T(s),x(T(s)))f(T(s),x(T(s)))$

$\psi(s,y(s)) = (T(s),x(T(s)))$

6
$(xt)$

ó
$h:$
$J \to$
$R$
$J$

$f$
ó
$\longmapsto$
$xt \longmapsto$
$h\,(xt)$
á
$D$
à
ó

ó
$D$
$t =$
$0$
ó
$f$
7
$J =$
$]\alpha, \beta[$
$\alpha, \beta \in$
$R$
$(t, x) \in$
$D$
í
$\frac{x}{t} \in$
$J$
ó
$f$
$\frac{x}{t} \in$
$J$
$\alpha <$
$xt <$
$\beta$
$(t, x) \in$
$D$
í
ó
$\frac{x}{t}$
$(t, x)$
$R^2$
ó
$x =$
$\alpha t$
$x =$
$\beta t$
$t$
$x =$
$0.4t$
$x =$
$0.8t$
$(0, 0)$
$D_+ =$
$\left\{(t, x) \in R^2 \mid t > 0, xt \in J\right\}$
$D_- =$
$\left\{(t, x) \in R^2 \mid t < 0, xt \in J\right\}$

ó
$\sqrt{x^2 + t^2}2x - t$

ó

é

ó

$(t_*, x_*) \in$

$R^2$

$\varphi :$

$\begin{cases} s = t - t_* \\ y = x - x_* \end{cases}$ $(t_*, x_*) \in$

$R^2$

á

$t$

$x$

$(a(s + t_*) + b(y + x_*) + cA(s + t_*) + B(y + x_*) + C)$

$\begin{cases} at_* + bx_* + c = 0 \\ At_* + Bx_* + C = 0 \end{cases}$

í

$(a(s + t_*) + b(y + x_*) + cA(s + t_*) + B(y + x_*) + C) =$

$h\,(as + byAs + By)$

ó

é

é

$\begin{vmatrix} a & b \\ A & B \end{vmatrix} \neq$

$0$

ó

$(t_*, x_*)$

ó

ó

é

$\begin{vmatrix} a & b \\ A & B \end{vmatrix} =$

$0$

á

$(a, b)$

$(A, B)$

á

$R^2$

$\in$

$R$

$(at + bx + cAt + Bx + C) =$

$h\,(at + bx + c(at + bx) + c)$

ó

é

$b \neq$

$0$

$a, b :$

$J \to$

$R$

$J$

ó

á

ó

$f :$

$J \times$

$R \to$

$R$

$*:$
$A\times$
$A\rightarrow$
$A$
$*$
$*b)*$
$c=$
$a*$
$(b*$
$c)\forall a,b,c\in$
$A$
$*$
$\exists e\in$
$A\mid$
$a*$
$e=$
$e*$
$a=$
$a\forall a\in$
$A$
$*$
$\forall a\in$
$A\exists b\in$
$A\mid$
$a*$
$b=$
$b*$
$a=$
$e$

$esunsubgrupodesiverificaque:$