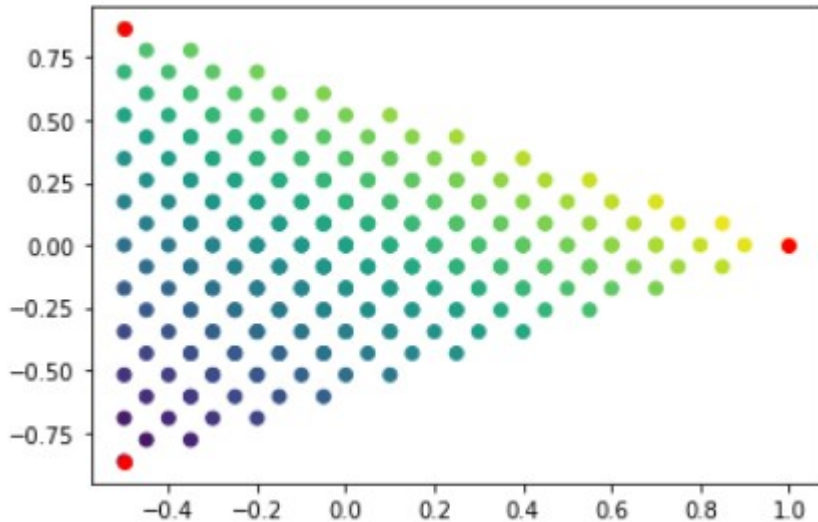


# Data creation

- use points uniformly distributed in 2D ,base-latent-space' with target =  $x+y$
- apply any kind of function to  $x$  and  $y$  to create coords in real space

base-latent-space

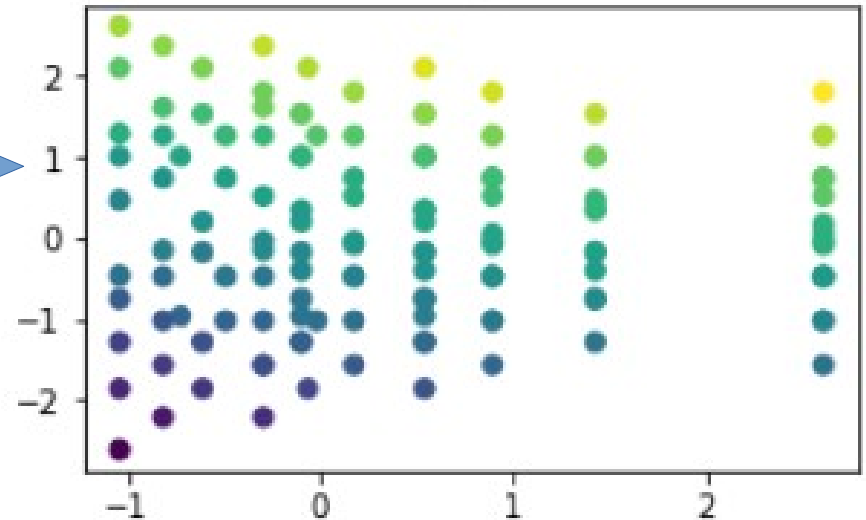


$$X' = \text{xfunc}(x)$$



$$Y' = \text{yfunc}(y)$$

real space



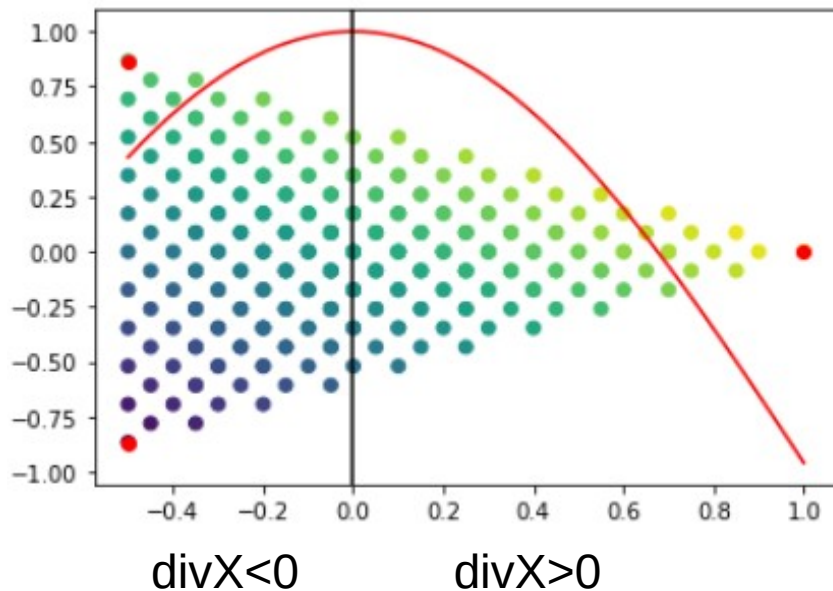
# Implications of data creation

- like this, for a perfectly working NN the derived latent space should be distributed uniformly, too
  - General usefulness of NN can be assessed by
    - comparing distribution in derived latent space to uniform distribution
    - MSE for features and target between real and reconstructed real space
- for transformation functions of varying complexity:
- 0: no transformation
  - 1: linear transformation
  - 2: monotonic non-linear (exp,  $x^3$ ,  $x^5$ , ...)
  - 3: non-monotonic non-linear (Gaussian)
  - 4: periodic (cos, sin)
- Calculations are started, waiting for result

# Do new points carry additional info?

## Proof of concept

- $x' = \cos(1.55 \cdot x)$ ,  $y' = y$
- Compare e.g. two cases:
  - Random division: NN trained with rand1, tested with rand2
  - Division at  $x=0$ : NN trained with  $\text{div}X < 0$ , tested with  $\text{div}X > 0$
- Former should work, latter should not



# Results for Proof of Concept

- how much latent space distribution deviates from uniform distribution is calculated in lat\_uniform with Hellinger Distance, in [0,1] → turns 0 for perfect uniform distribution

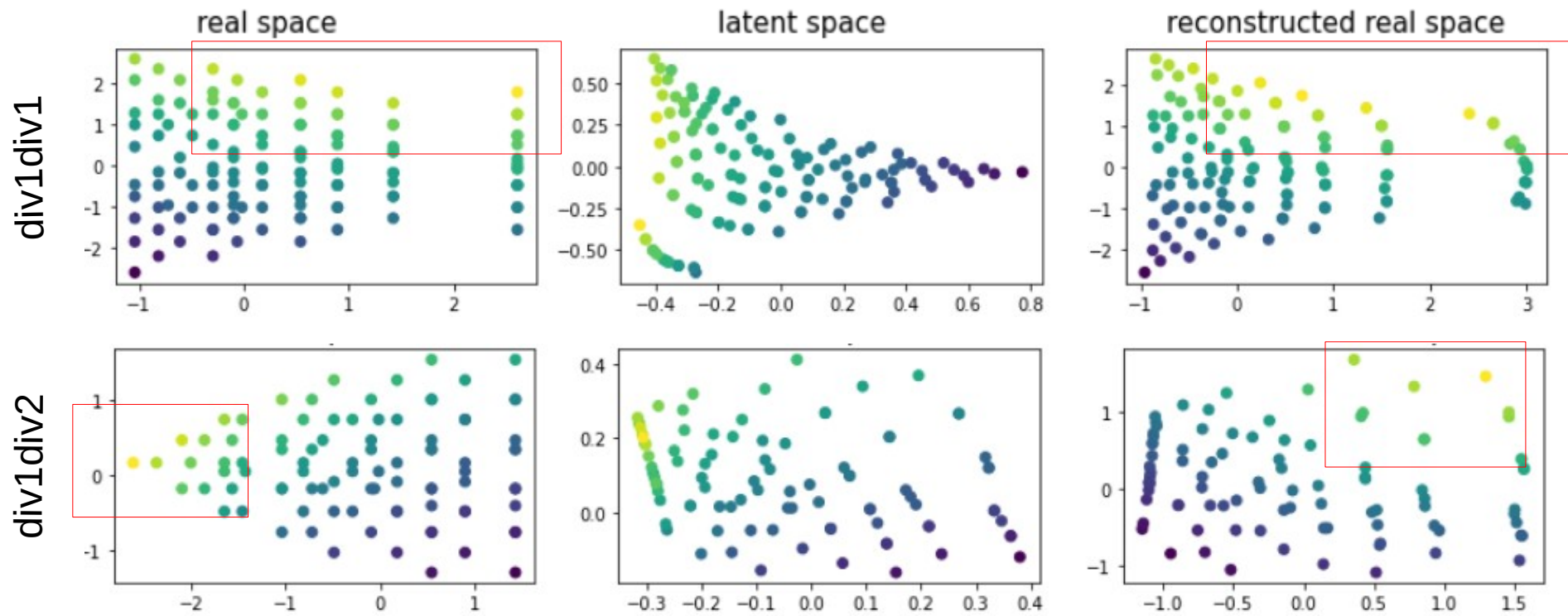
		MSE_feats	MSE_targets	lat_uniform
<div>Train set</div> <div>Test set</div>	div1div1	(0.051, 0.067)	(0.02, 0.017)	(0.481, 0.137)
	div1div2	(0.043, 0.019)	(2.411, 0.162)	(0.548, 0.051)
	rand1rand2	(0.047, 0.036)	(0.239, 0.021)	(0.389, 0.073)
	div1both	(0.052, 0.045)	(1.038, 0.089)	(0.445, 0.085)
	bothdiv1	(0.029, 0.013)	(0.282, 0.2)	(0.507, 0.109)

(mean, std.dev.) for 20 calculations, with each #epochs=1000

- results: MSE\_targets seems to be a reliable metric: it increases when new data points carry new information and cannot be predicted well with old model.

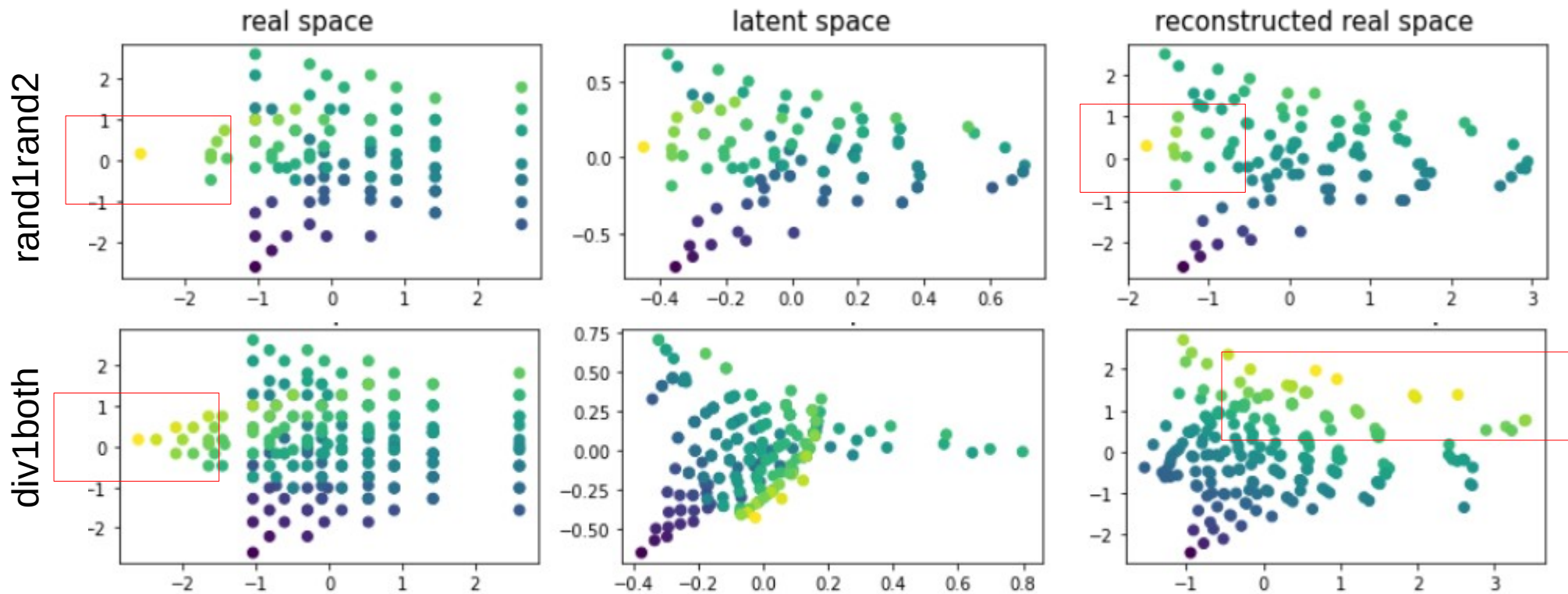
# Results for Proof of Concept

Example calculations: Test points shown in all diagrams



# Results for Proof of Concept

Example calculations: Test points shown in all diagrams



# Result analysis & next steps

- As was to be expected, data points that carry new information cannot be predicted well with old NN
- New points are not displayed outside latent space, hypothesis: setup of NN does not allow for any point to be placed outside
- If target values are unknown for new points, until now not clear if NN suitable for their prediction
- Next step: Check if clustering of new-information carrying points occurs inside latent space