

当チームの目標と研究内容

目標と背景

- 目標：橋梁などインフラ構造物の維持管理をAI・ロボット技術で効率化・高度化
- 技術課題①：画像等を自動撮影可能なロボット ← 世界中で進む自律UAVを活用
- 技術課題②：画像等を元に**対象物の状況を理解し、説明できるAI**の開発

- マルチモーダルAI（GPT4vなど）が大きく進展し、実社会応用への適用が期待

研究成果（2023年発表）

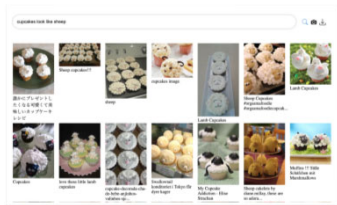
- マルチモーダルAIを用いた対話型橋梁点検AI [Kunlamai+, Computer Aided Civil and Engineering誌]
- 無教師ドメイン適応画像セグメンテーション [Wang+, Computer Vision and Image Understanding誌]
- 未知空間を探索するAIエージェント[Liu+, International Journal of Computer Vision誌]

(本ポスターの内容)

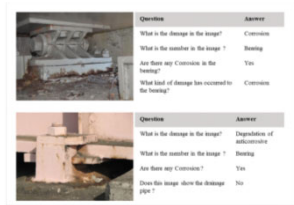
課題

- 「専門家の知識」を、デジタルデータにしAIに学習させるには？

ウェブ上のデータ



専門家を持つ知識



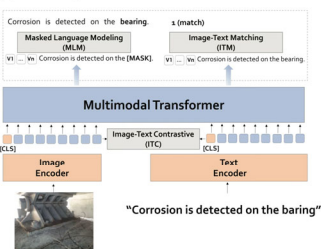
VS



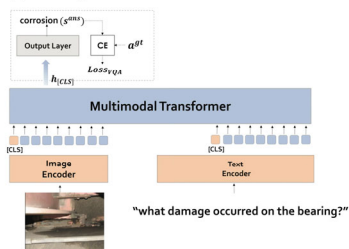
マルチモーダル事前学習

- 橋梁の変状(異常)の画像とその説明文のペアを学習
- トランスフォーマーに基づくマルチモーダル融合AI

(A) Pretraining Phase



(B) Finetuning Phase



性能評価・動作例

- 正答率：88.3%
- 事前学習なしの正答率(78.0%)から10ポイントのアップ



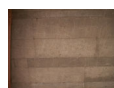
Are there any cracking?
GT: yes
Pred: yes



Does this image show the drainage pipe?
GT: no
Pred: no



Are there any corrosion?
GT: yes
Pred: yes



Are there any cracking in the slab?
GT: yes
Pred: yes



What is the member that has corrosion?
GT: expansion joint
Pred: expansion joint



What is the member in the image?
GT: bearing
Pred: bearing



What is the member that has corrosion?
GT: drainage pipe
Pred: drainage pipe



What is the member in the image?
GT: parapet wall
Pred: parapet wall

マルチモーダルAIの橋梁点検への応用

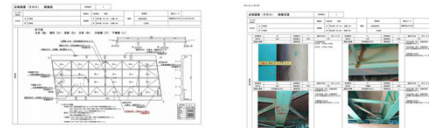
- 新米点検員に熟練者の知識と経験を与える
- 人とAIとの対話で理解をより深める



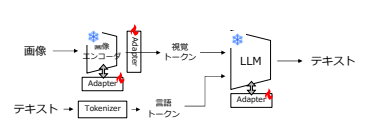
Question	Answer
What is the damage in the image?	Corrosion
What is the member in the image ?	Bearing
Are there any Corrosion in the bearing?	Yes
What kind of damage has occurred to the bearing?	Corrosion

アプローチ

- 既存の「点検レポート」を学ばせる = マルチモーダル事前学習



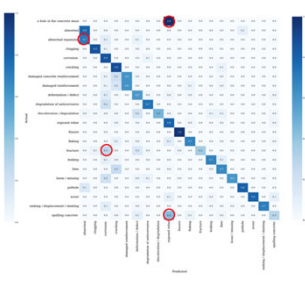
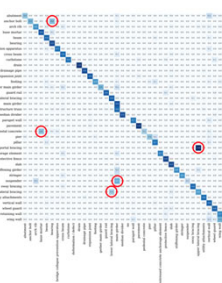
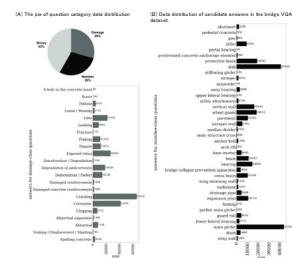
- AI向け教科書の作成・言語モデルとの融合



データ

- 点検調書から抽出
 - 関東地方整備局が保有する2014年～2018年分の点検調書
 - 東京大学全准教授との共同研究
- 3,118橋の421,956画像

421956 images				
VLP		VQA		
295346 images		126610 images		
Training	Validation	Training	Validation	Testing
235769	59577	88565	1892	11121
事前学習データ				
Q&A学習データ				
Stage	Data	No. samples		
		Train	Val	Test
VLP	Bridge image captioning data	235769	59577	-
VQA	Bridge-inspection VQA dataset	610197	130122	131774



<p>what is the member in the image? Ground truth: Bearing Pred answer: Bearing</p>	<p>what is the member that has cracking? Ground truth: Vertical wall Pred answer: Vertical wall</p>	<p>what is the member that has clogging? Ground truth: Expansion joint Pred answer: Expansion joint</p>	<p>what is the damage in the image? Ground truth: Cracking Pred answer: Cracking</p>	<p>what is the damage in the image? Ground truth: Sinking / displacement / starting Pred answer: Sinking / displacement / starting</p>	<p>what kind of damage has occurred to the main girder? Ground truth: Flange Pred answer: Flange</p>
<p>what is the member in the image? Ground truth: Protective fence Pred answer: Protective fence</p>	<p>what is the member in the image? Ground truth: Drainage pipe Pred answer: Drainage pipe</p>	<p>what is the member in the image? Ground truth: Pavement Pred answer: Pavement</p>	<p>what kind of damage has occurred to the drain? Ground truth: Clogging Pred answer: Clogging</p>	<p>what is the damage in the image? Ground truth: Leaking Pred answer: Leaking</p>	<p>what kind of damage has occurred to the main girder? Ground truth: Flaking Pred answer: Flaking</p>