

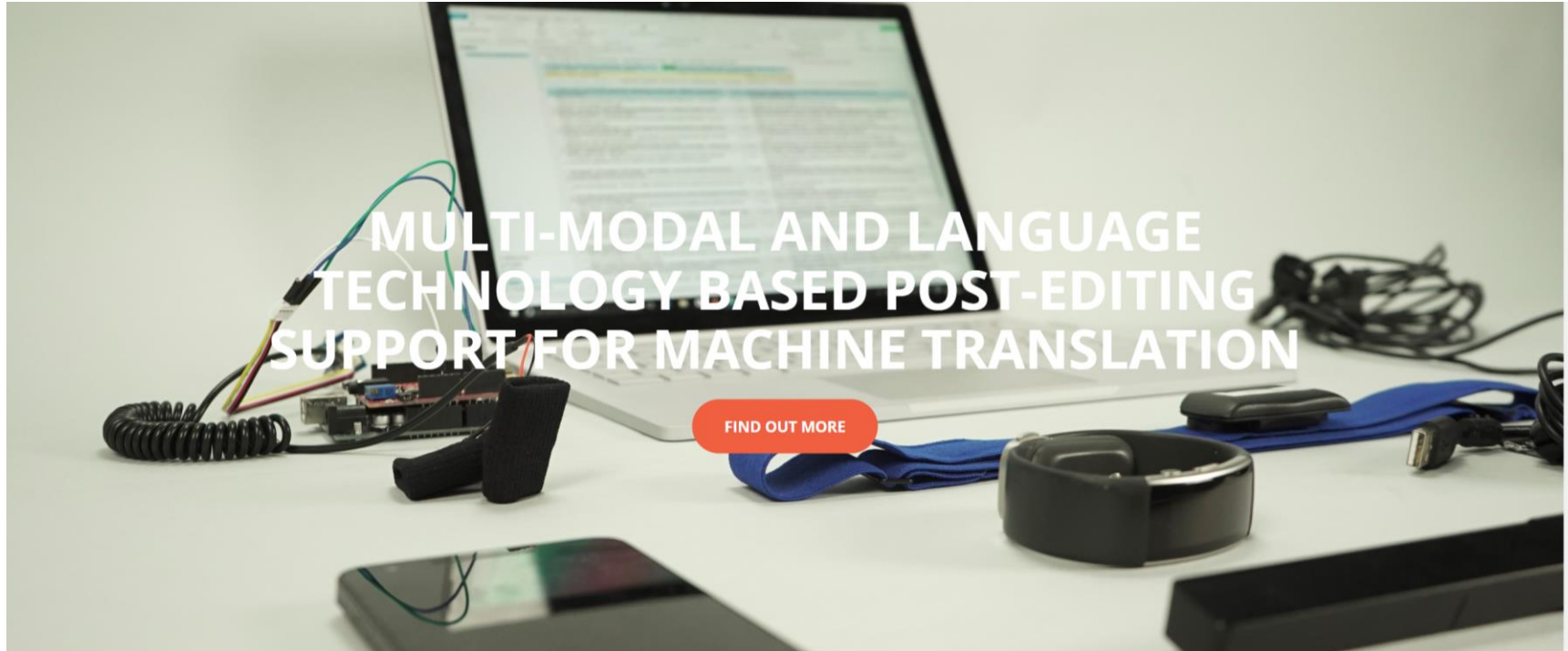
## MMPE - Multimodal Post-Editing

Nico Herbig, S. Pal, R. Jamara, T. Düwel, R. Shenoy,  
K. Meladaki, M. Monshisadeh, V. Hnatovskiy, A. Krüger,  
J. van Genabith



Josef van Genabith  
josef.van\_genabith@dfki.de





- DFKI, MLT lab @DFKI & COS lab @DFKI
- Human/Machine collaboration: [Nico Herbig](#), [MMPE](#), multimodal postediting, [CHI 2019](#), [ACL 2020a](#), [ACL 2020b](#), [ACL-IJCNLP 2021](#)



Show, don't tell





- Post-editing (PE)

# Human/Machine Collaboration



English→German		
Ave.	Ave. z	System
90.3	0.347	Facebook-FAIR
93.0	0.311	Microsoft-WMT19-sent-doc
92.6	0.296	Microsoft-WMT19-doc-level
90.3	0.240	HUMAN
87.6	0.214	MSRA-MADL
88.7	0.213	UCAM
89.6	0.208	NEU
87.5	0.189	MLLP-UPV
87.5	0.130	eTranslation
86.8	0.119	dfki-nmt
84.2	0.094	online-B
86.6	0.094	Microsoft-WMT19-sent-level
87.3	0.081	JHU
84.4	0.077	Helsinki-NLP
84.2	0.038	online-Y
83.7	0.010	lmu-ctx-tf-single
84.1	0.001	PROMT-NMT
82.8	-0.072	online-A
82.7	-0.119	online-G
80.3	-0.129	UdS-DFKI
82.4	-0.132	TartuNLP-c
76.3	-0.400	online-X
43.3	-1.769	en-de-task

WMT 2019

# Human/Machine Collaboration



- Machine translation getting pretty good
- For some language pairs/domains with ample training data
- Still, MT makes mistakes ... humans too ...
- Especially for language pairs/domains where we do **not** have **soooo** much training data
- We can't just rely on the machine to produce publishable output
- We have to check MT output, find and correct the mistakes
- This is called “**post-editing**” (PE)
- human in the loop – human-machine collaboration

An increasingly common workflow in professional translation:

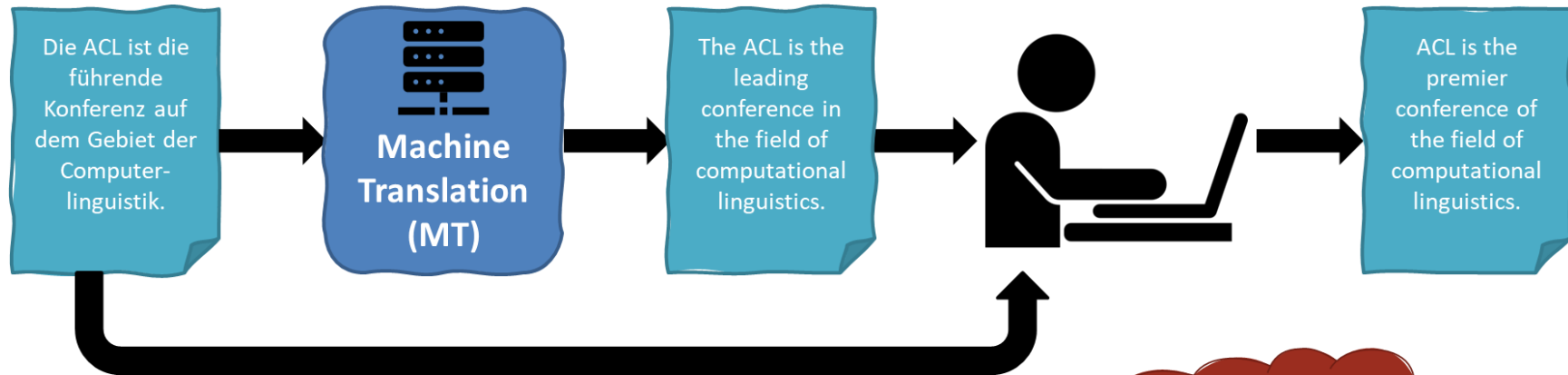
1. Raw MT output
2. PE of MT output in CAT tool by professional human translator

CAT tool: computer assisted translation

SDL Trados, MateCat, many many others ...



# Human/Machine Collaboration



PE **saves time** and **reduces errors** [Green et al. 13]

# Human/Machine Collaboration



SDL Trados Studio - JD- Manager Real Estate v0.1.doc\_en-US-ar-EG

File Edit View Translation Format Project Tools Help

Open Document... New Project... Open Package...

Display: All segments Containing: In Source

Editor MoKa.sdlm - Concordance Search

Table Row	Source	Match	Target	TC
Strategic	Strategic	100%	استراتيجية	TC
Work with the Deputy CEO to implement strategic priorities for the Company's projects in terms of commercial management, project management, and financial management.	100%	العامل مع نائب المدير التنفيذي لتطبيق الأولويات الاستراتيجية لمشروعات الشركة من حيث الإدارة التجارية، إدارة المشاريع، الإدارة المالية.	TC	
Review and assess, based on CEO / BOD assignment, key business units and submit objective views that will help the Board engage in long term strategic decisions.	100%	المراجعة والتقييم بناءً على تكليف من المدير التنفيذي أو مجلس الإدارة، الوحدات الأساسية للأعمال وتقديم آراء موضوعية تساعد مجلس الإدارة في الاشتراك في قرارات استراتيجية طويلة الأجل.	TC	
Assist the CEO in reviewing group and strategic objectives and suggesting changes wherever needed.	100%	مساعدة المدير التنفيذي في مراجعة الأهداف الجماعية والاستراتيجية وإقرار التفسيرات حين الحاجة.	TC	

MoKa.sdlm 11/13/2012 12:55:27 PM Seven7-PC(Seven7)

JD- Manager Real Estate v0.1.doc[Translation en-US-ar-EG]\*

9 **Reporting to**

10 **Subordinate positions**

11 Head of Real Estate & Property Management

12 Assistant Manager Real Estate

13 **Job Summary:**

14 The main role of the Real Estate Manager is to be accountable for the overall management of residential / commercial properties on behalf of and to the satisfaction of, REAM and the tenants / clients.

15 **Strategic**

16 Assist the Head of Real Estate and Property Management in the preparation of annual budgets, forecasts & reports.

17 Oversee contracting, collection activities and maintenance for REAM's properties.

18 **Operational**

19 Coordinate the real estate management team to ensure that high quality services are consistently provided to owners and tenants in the management of properties.

المدير المباشر  
الوظائف التابعة  
المدير المساعد لإقليم العقارات  
ملخص الوظيفة:  
الدور الأساسي لمدير قسم العقارات هو أن يكون مسؤولاً عن الإدارة الكاملة للإقليم العقارية الإيجارية / التجارية نابعة عن شركة "ريم" والمستأجرين / العملاء وما يرضيهم.  
إستراتيجية  
مساعدة رئيس قسم إدارة العقارات والإقليم العقارية في إعداد الميزانيات السنوية و التوقعات والتقارير.  
مراقبة التعاقدات وأنشطة التحصيل والصيانة للأملك العقارية لشركة "ريم".  
إجرائية  
التعاون مع فريق إدارة العقارات لضمان تقديم خدمات عالية الجودة باستمرار في إدارة الأملك العقارية للملاك والمستأجرين.

INS 76.80% 23.20%

# Human/Machine Collaboration





- Compared to past, less translation from scratch
- From text production to text editing/revision of MT/TM
- Interaction changes from **text generation/production** to **editing text**
- Changes **interaction modalities?**
- Traditional: **mouse, keyboard, trackpad**
- Other interaction modalities?
- **Pen, touch (screen), speech, gesture, gaze, ... MMPE**
- NLP support: e.g. **QE, APE, ... MMPE**

- **Trans. from scratch vs. TM vs. MT: use MT 80% of the time** [Vela et al. 19]
- **Task changes from control to supervision**  
→ **significantly less mouse and keyboard**  
[Green et al. 13]



# Eliciting Multi-Modal Interactions for Post-Editing

Herbig, N., Pal, S., Van Genabith, J., & Krüger, A. (2019). Multi-modal Approaches For Post-editing Machine Translation. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (Pp. 1-11).

## Which PE tasks might be best supported by which modalities?



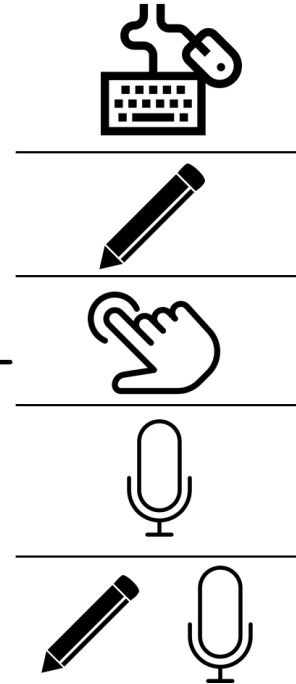
### Elicitation Study

- Avoid technical thinking
- Assume perfect recognition
- Present “referents”, let participants propose actions
- Increased immediate usage

Vatavu, R., Wobbrock, J. (2015). Formalizing Agreement Analysis for Elicitation Studies: New Measures, Significance Test, and Toolkit. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (1325–1334).



13 Professional Translators (f=9)  
8 in-house, 5 freelance





- MT + PE saves time and money
- Interaction modalities?
- Elicitation study (Herbig et al. CHI 2019)
- Professional human translators
  - Outcomes: penn, touch, speech + keyboard and mouse
  - Gesture and gaze seen as less promising
- MMPE prototype and evaluation (Herbig et al. ACL 2020a, 2000b)





# The MMPE Prototype

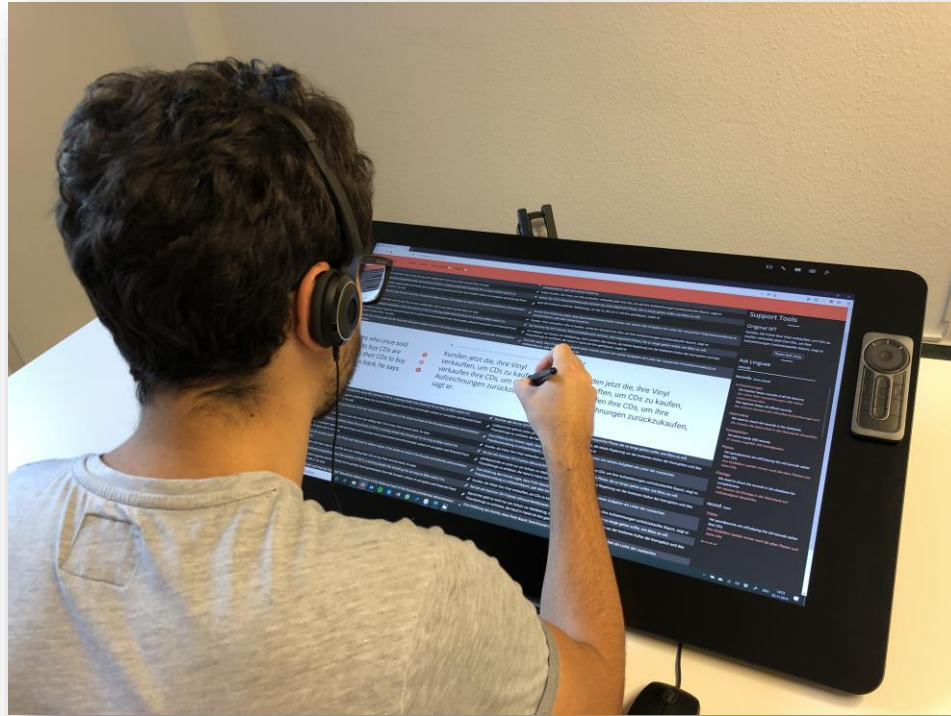
Herbig, N., Pal, S., Düwel, T., Meladaki, K., Monshizadeh, M., Hnatovskiy, V., Krüger, A. & Van Genabith, J. (2020). MMPE: A Multi-modal Interface Using Handwriting, Touch Reordering, and Speech Commands for Post-Editing Machine Translation. In *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics: System Demonstrations* (Pp. 327-334).

# Human/Machine Collaboration

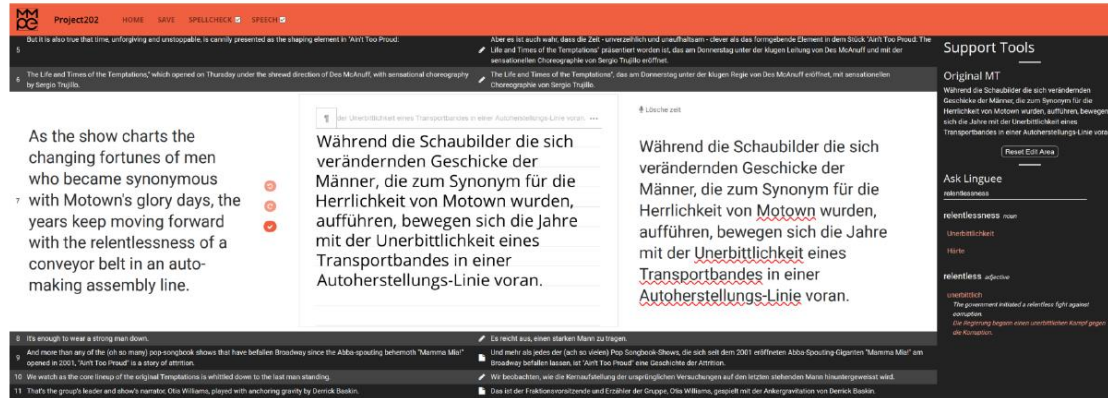


- MMPE prototype: touch, pen and speech
- Large tiltable touch & pen screen
- Headset for speech input
- ASR, hand-writing recognition
- Buttons on screen, hot keys, keyboard & mouse

# Human/Machine Collaboration



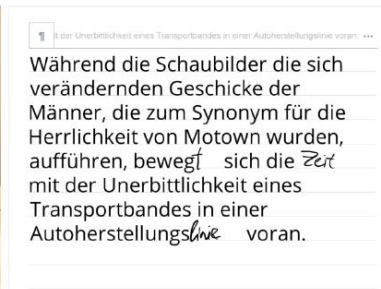
# Human/Machine Collaboration



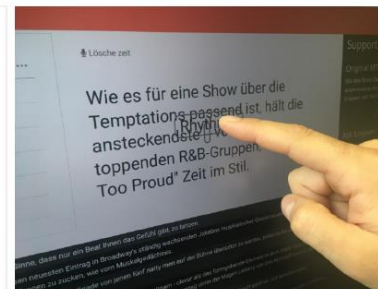
(a) Screenshot of the interface.



(b) Apparatus.



(c) Handwriting on left target view.



(d) Touch reordering on right target view.

# Human/Machine Collaboration

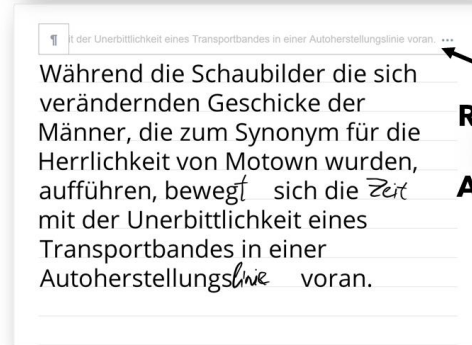
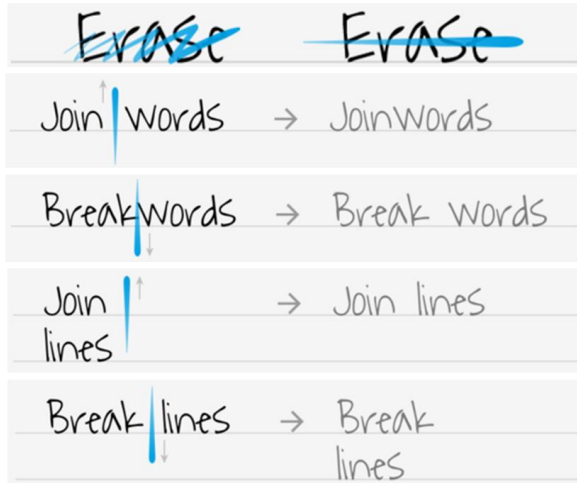


The screenshot displays a machine translation tool interface. At the top, there's a navigation bar with options like 'HOME', 'SAVE', 'SPELLCHECK', 'WHITESPACE', 'EYE TRACKING', and 'SPEECH'. The main content area shows a German sentence: "Kunden, ja früher Vinyl, um CDs zu kaufen, verkaufen jetzt ihre CDs, um ihre Aufzeichnungen zurückzukaufen", sagt er. Below it, the English translation is: "Customers who once sold their vinyl to buy CDs are now selling their CDs to buy their records back, he says." To the left, a list of 22 source sentences is visible, many of which are identical to the one being translated. On the right, there's a 'Support Tools' sidebar with sections for 'Original MT', 'Ask Linguee', and 'CUSTOMERS'. The 'Ask Linguee' section shows a list of customer-related terms and their translations. The 'CUSTOMERS' section shows a list of customer-related terms and their translations.

## Handwriting



### Gestures:



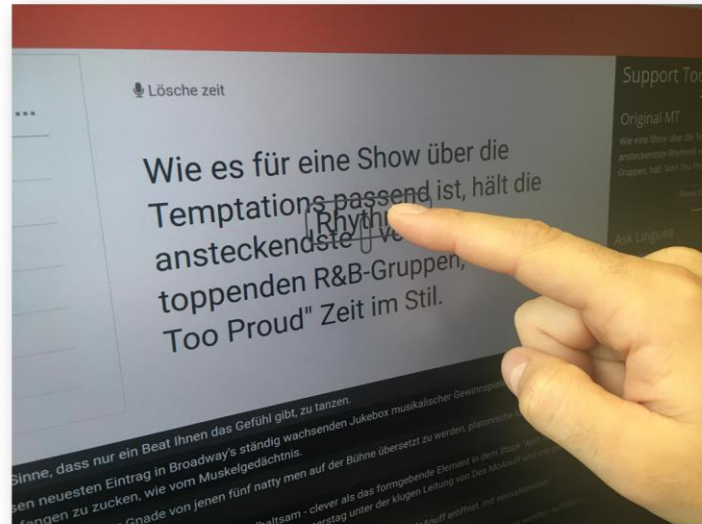
**Recognition & Alternatives**

## Touch Mouse & Keyboard

**Touch Deletion:**  
Double Tap

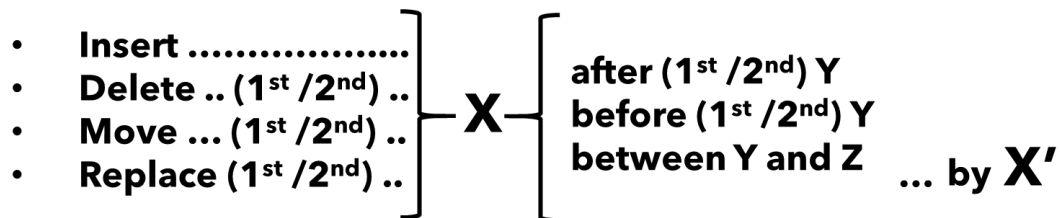
**Touch Reorder:**  
Drag and Drop

**Mouse & Keyboard:**  
As usual

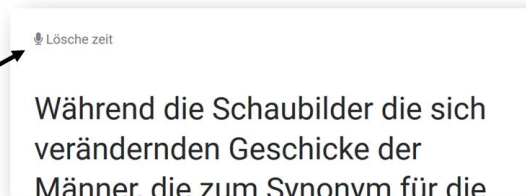




## Commands

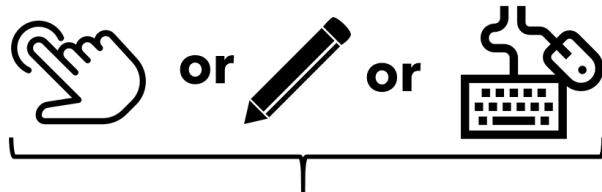


**Recognized  
Command**





## Multi-Modal Combinations



**Select Word/Position**

+



**Simplified Command**

- *"Delete"*
- *"Insert X"*
- *"Move after Y"*
- *"Replace by X"*

## Logging



### Low-level:

Concrete keystrokes, touched coordinates, ...

### High-level:

#### Text manipulations

- Insert\_single/group with inserted words
- Delete\_single/group with deleted words
- Reorder\_single/group with old and new positions
- Replace\_partial/single/group with old and new word(s)

```
{ "type": "SPEECH_INPUT_ACTIVATION", "interactionSource": "UI", "interactionModality": "MOUSE", "ts": 1596114930776, "participant": 1, "segmentID": 5 }
{ "type": "DELETE_SINGLE", "interactionModality": "SPEECH", "interactionSource": "MICROPHONE", "segmentTextOld": "\n Kunden, die fr\u00fcher ihre Vinyl verkauften, um CDs zu kaufen, verkaufen jetzt ihre CDs, um ihre Schallplatten zur\u00fcckzukaufen", "segmentTextNew": "\n Kunden, die fr\u00fcher ihre verkauften, um CDs zu kaufen, verkaufen jetzt ihre CDs, um ihre Schallplatten zur\u00fcckzukaufen", "position": "char:26", "word": "Vinyl", "ts": 1596114957569, "participant": 1, "segmentID": 5 }
{ "type": "INSERT_SINGLE", "interactionModality": "PEN", "interactionSource": "IINK", "segmentTextOld": "\n Kunden, die fr\u00fcher ihre verkauften, um CDs zu kaufen, verkaufen jetzt ihre CDs, um ihre Schallplatten zur\u00fcckzukaufen", "segmentTextNew": "\n Kunden, die fr\u00fcher ihre Schallplatten verkauften, um CDs zu kaufen, verkaufen jetzt ihre CDs, um ihre Schallplatten zur\u00fcckzukaufen", "position": "word6", "word": "Schallplatten", "ts": 1596114997526, "participant": 1, "segmentID": 5 }
{ "type": "REPLACE_SINGLE", "interactionModality": "KEYBOARD", "interactionSource": "MAIN", "segmentTextOld": "\n Kunden, die fr\u00fcher ihre Schallplatten verkauften, um CDs zu kaufen, verkaufen jetzt ihre CDs, um ihre Schallplatten zur\u00fcckzukaufen", "segmentTextNew": "\n Kunden, die fr\u00fcher ihre Schallplatten verkauften, um CDs zu kaufen, verkaufen jetzt ihre CDs, um ihre Vinyl zur\u00fcckzukaufen", "position": "word21", "wordOld": "Schallplatten", "wordNew": "Vinyl", "ts": 1596115019597, "participant": 1, "segmentID": 5 }
{ "type": "SEGMENT_CONFIRM", "interactionModality": "MOUSE", "interactionSource": "UI", "segmentText": "\n Kunden, die fr\u00fcher ihre Schallplatten verkauften, um CDs zu kaufen, verkaufen jetzt ihre CDs, um ihre Vinyl zur\u00fcckzukaufen", "duration": 105170, "ts": 1596115022794, "participant": 1, "segmentID": 5 }
{ "type": "SEGMENT_SELECT", "interactionSource": "UI", "interactionModality": "MOUSE", "ts": 1596115022799, "participant": 1, "segmentID": 6 }
```

**+** Modality

# Human/Machine Collaboration



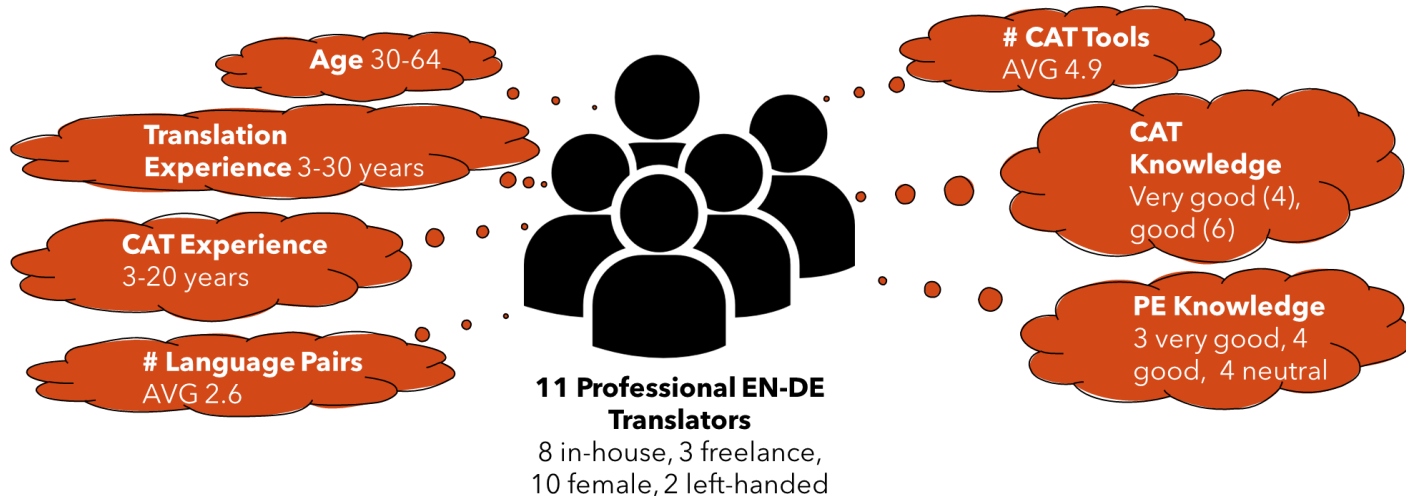
- MMPE video



# Evaluating the MMPE Prototype with Professional Translators

Herbig, N., Düwel, T., Pal, S., Meladaki, K., Monshizadeh, M., Krüger, A., & van Genabith, J. (2020). MMPE: A multi-modal interface for post-editing machine translation. In *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics* (pp. 1691-1702).

## Participants



## Evaluation

### 1. Introduction

- Questionnaire on demographics & CAT usage
- Presenting prototype features in prepared order

### 2. Independent Exploration

- 10-15 minutes exploration on their own
- Resolve questions & become familiar

#### REORDER with Pen

##### Source:

From 1872, Dr. Bernhard von Gudden led the institution – the psychiatrist who is associated with the death of King Ludwig II.

##### MT:






Ab 1872 leitete Dr. Bernhard von Gudden die Einrichtung - Psychiater jener, der in Zusammenhang mit dem Tod von König Ludwigs II. gebracht wird.

##### Correction to apply:

Ab 1872 leitete Dr. Bernhard von Gudden die Einrichtung - **jener** Psychiater **jener**, der in Zusammenhang mit dem Tod von König Ludwigs II. gebracht wird.

START

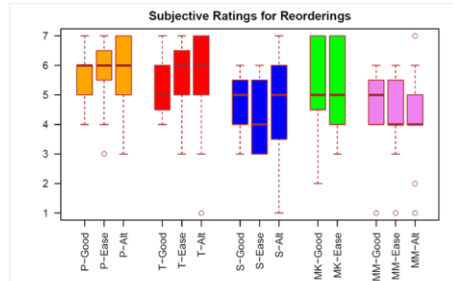
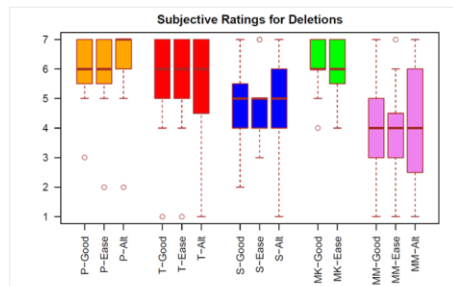
### 3. Guided, feature-wise test

- EN-DE WMT 2018 test data, manually introduced errors → only a single error
- 80 segments
  - 4 sentences with
  - 4 operations (insert, delete, reorder, replace) with
  - 5 modalities (      )
- Popup showing what to do  
→ consistent editing behavior, comparable ratings
- After each operation
  - 7-point scale rating per modality, if *interaction*
    - *is a good match for its intended purpose*
    - *is easy to perform*
    - *is good alternative to mouse & keyboard*
  - Interview on advantages/disadvantages/ideas for improvement
  - Order modalities from best to worst

### 4. Final unstructured interview

- Capture high-level feedback
- Missing features

## Results: Subjective Ratings

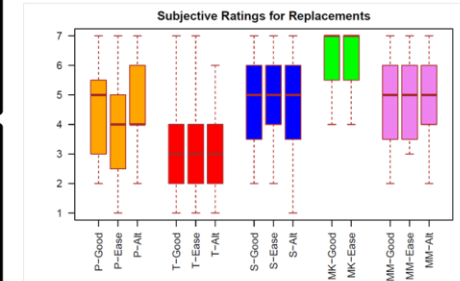
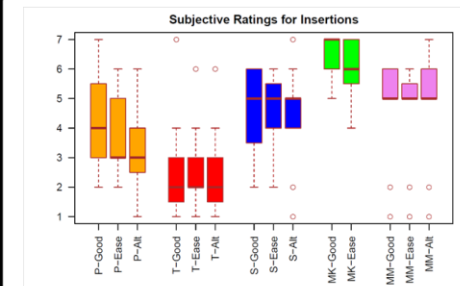


**No text input:**

- best
- worse





**Text input:**

- best
- good
- worse























Icon by Smashicons, Zlatko Najdenovski, Pixel perfect, Hanan and Freepik from flaticon.com

## Results: Orderings

Example: "Ψ &  best, then , then , and last 

$\frac{1}{2}$  1<sup>st</sup>    $\frac{1}{2}$  1<sup>st</sup>                      3<sup>rd</sup>                      4<sup>th</sup>                      5<sup>th</sup>  
 $\frac{1}{2}$  2<sup>nd</sup>    $\frac{1}{2}$  2<sup>nd</sup>

Multiply position by 1, 2, 3, 4, 5 and sum up across participants → Lower score = better

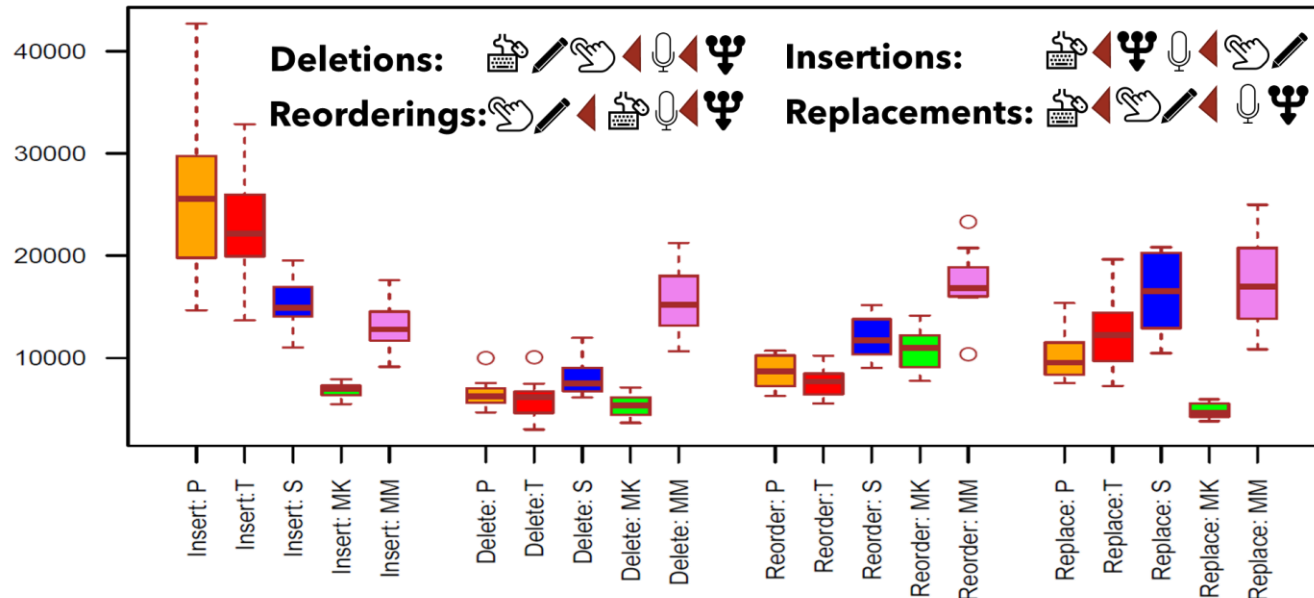
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>
<b>Deletions</b>	21.5 	29 	31.5 	41 	42 
<b>Reorderings</b>	21.5 	31 	35.5 	36 	41 
<b>Insertions</b>	20.5 	26.5 	31.5 	38.5 	48 
<b>Replacements</b>	21 	29 	30 	35 	50 



# Human/Machine Collaboration: MMPE




## Results: Timings



## Results & Discussion

- **Deletions & Reorderings:**
  - Very good ratings, order, timing
  - Enthusiastic comments
- **Insertions & Replacements:**
  - Worst ratings, order
  - Only for short modifications
- **Concern:** need to think about space
-  **vs.**  : Pen more precise



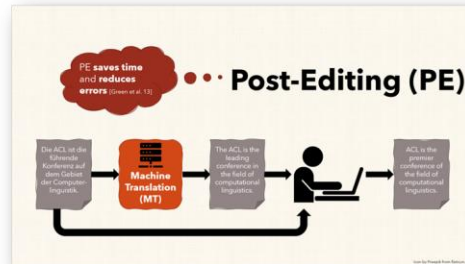
- **Deletions & Reorderings:**
  - Worst ratings, order, timing
- **Insertions & Replacements:**
  - Good (but  better)
- **Concern:** formulate commands while mentally processing text
-  **vs.** :
  - Multi-modal when ambiguities
  - Timing inconclusive



- **Insertions & Replacements & Deletions:**
  - Very good ratings, order, timing
- **Reorderings :**
  - Worse ratings, order, timing
- **Concern:** needs "years of expertise", "unintuitive"



## Summary



**How does this affect the design of translation environments? Which interactions should best be used for PE?**


Trans. from scratch vs. TM vs. MT: use MT 80% of the time (Yeh et al. 19)


- Task changes from control to supervision
- significantly less mouse and keyboard

(Green et al. 13)

Kunden, die früher ihre Vinyl verkaufen, um CDs zu kaufen, verkaufen jetzt ihre CDs, um ihre zurückzukaufen, sagt er.

### Discussion

- Deletions & Reorderings:**
  - Very good ratings, order, timing
  - Enthusiastic comments
- Insertions & Replacements:**
  - Worst ratings, order
  - Only for short modifications
  - Concern:** need to think about space
- vs. ** Pen more precise

- Deletions & Reorderings:**
  - Worst ratings, order, timing
- Insertions & Replacements:**
  - Good (but not better)
  - Concern:** formulate commands while mentally processing text
- vs. ** More modal when ambiguities
- Timing inconclusive

- Insertions & Replacements & Deletions:**
  - Very good ratings, order, timing
- Reorderings:**
  - Worse ratings, order, timing
- Concern:** needs "years of expertise", "unintuitive"



# Mid-Air Hand Gestures for Post-Editing of Machine Translation

Jamara, R., Herbig, N., Krüger, A., & van Genabith, J. (ACL-IJCNLP 2021).  
Mid-Air Hand Gestures for Post-Editing of Machine Translation.

## Gesture-Based PE: The Idea

Use hand gestures as a mouse replacement in combination with the keyboard to perform PE tasks

- Move the cursor
- Reorder, replace, delete directly

Why?



No switching to  
mouse

Gestures common in daily  
communication

Sharma, R. P., & Verma, G. K. (2015). Human computer interaction using hand gesture. *Procedia Computer Science*, 54, 721-727.

Give us a sense of control  
and easiness

Ortega, M., & Nigay, L. (2009). AirMouse: Finger gesture for 2D and 3D Interaction. In *IFIP Conference on Human-Computer Interaction* (pp. 214-227). Springer, Berlin, Heidelberg.

Explore feasibility



Which gestures might be suitable for which PE tasks?



## Gesture Elicitation Study

- No universal gesture set for all applications

Nielsen, M., Störring, M., Moeslund, T. B., & Granum, E. (2003). A procedure for developing intuitive and ergonomic gesture interfaces for HCI. In International gesture workshop (pp. 409-420). Springer.



Online with  
14 Freelance Translators

## Referents

Insertion

Delete single &  
group

Reorder single &  
group

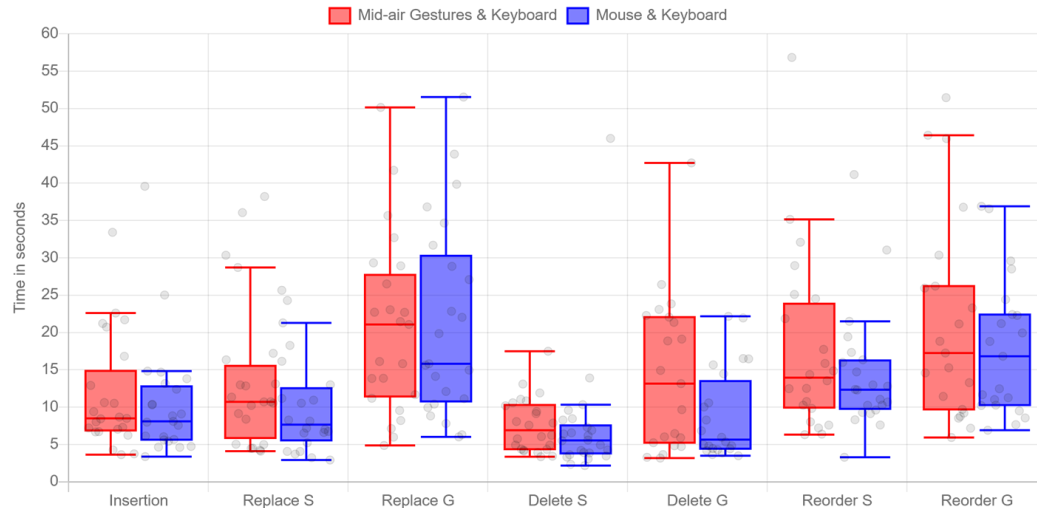
Replace single &  
group



- Video

## Evaluation: Timings

8 Researchers (due to Corona)



- **Gestures slower, but relatively close to mouse & keyboard**  
→ Even though years of experience with mouse & keyboard
- **Single item operations faster than group operations**  
→ Due to group selection



# Human/Machine Collaboration: Gestures



## Discussion

### Pros

- Much more efficient than we expected
- Worked quite well for single item manipulations

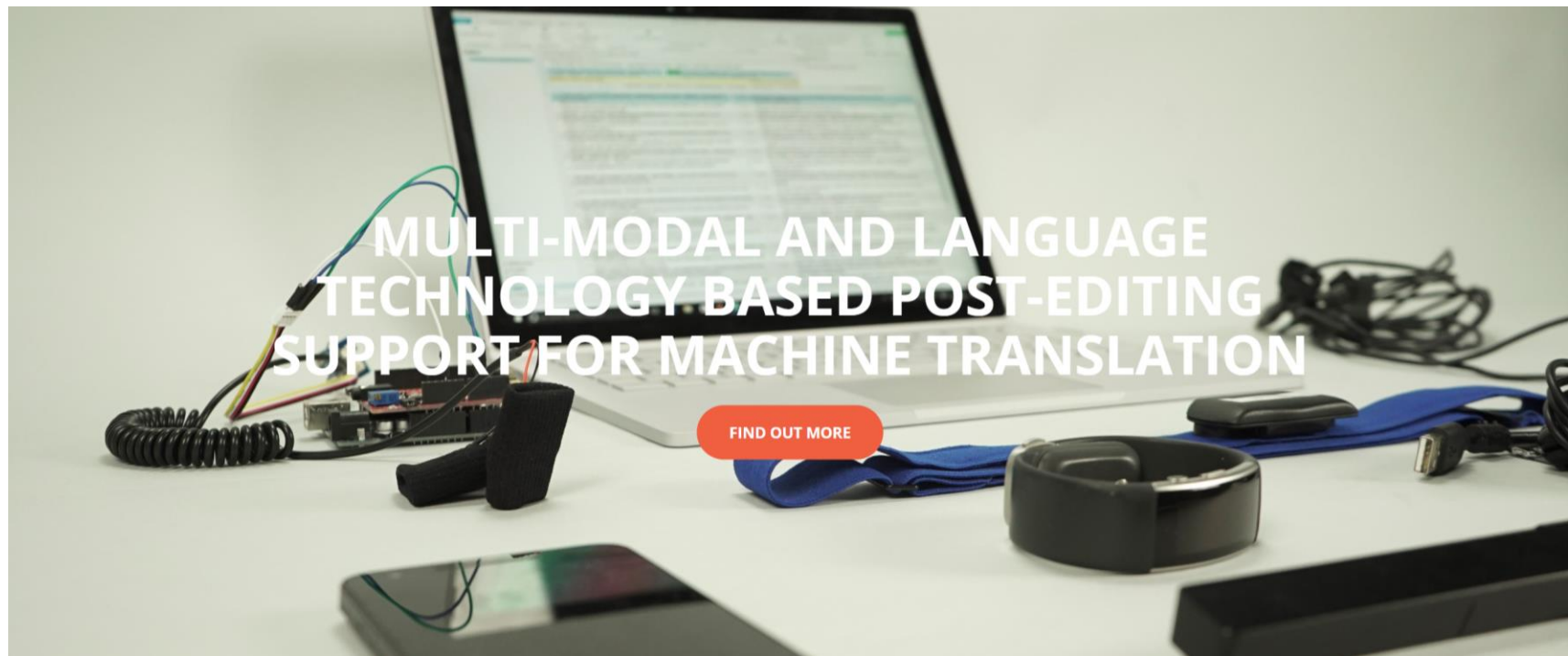
### Cons

- Group operations require further work
- Study with professional translators needed after pandemic





- The end 😊





- **Question–Answering and Information Extraction:** Prof. Dr. Günter Neumann

- Neural text processing, text analytics, open relation extraction and QA pipelines. Medical, automotive and general domains
- Projects: Nuance, Amplexor, Deeplee, iRead, Precise4Q



- **Machine Translation:** Dr. Cristina España i Bonet

- Neural Machine Translation/Automatic Post-Editing and Quality Estimation, Self-Supervised Learning from Comparable Data. Medical, IT and general domains
- Projects: Amplexor, SAP, Deeplee, ELG

- **Talking Robots Group:** Dr. Ing. Ivana Kruijff-Korbayová

- Neural Learning for Goal-Oriented Dialog
- Projects: A-DRZ, Intuitiv. Rescue robotics and patient care



**A-DRZ**

Aufbau des Deutschen Rettungsrobotik-Zentrums



- **Data and Resources:** Dr. Andrea Lösch

- Language Technology needs data
- Projects: ELRC CEF SMART



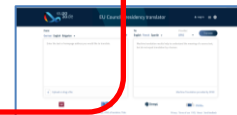
- **Question–Answering and Information Extraction:** Prof. Dr. Günter Neumann

- Neural text processing, text analytics, open relation extraction and QA pipelines. Medical, automotive and general domains
- Projects: Nuance, Amplexor, Deeplee, iRead, Precise4Q



- **Machine Translation:** Dr. Cristina España i Bonet

- Neural Machine Translation/Automatic Post-Editing and Quality Estimation, Self-Supervised Learning from Comparable Data. Medical, IT and general domains
- Projects: Amplexor, SAP, Deeplee, ELG



- **Talking Robots Group:** Dr. Ing. Ivana Kruijff-Korbayová

- Neural Learning for Goal-Oriented Dialog
- Projects: A-DRZ, Intuitiv. Rescue robotics and patient care



**A-DRZ**

Aufbau des Deutschen Rettungsrobotik-Zentrums

- **Data and Resources:** Dr. Andrea Lösch

- Language Technology needs data
- Projects: ELRC CEF SMART



The background of the slide is a photograph of the European Parliament building in Brussels. The building's curved facade and glass windows are visible. In the foreground, a row of flagpoles holds the national flags of various European countries, including the European Union flag. The text 'European Language Resource Coordination — supporting Multilingual Europe' is overlaid on the image in a white, sans-serif font. A yellow button with the text 'ELRC-SHARE' and a right-pointing arrow is positioned in the lower-left area of the image.

## European Language Resource Coordination — supporting Multilingual Europe

ELRC-SHARE

# MT Group @ MLT Lab @DFKI



The screenshot shows the 'EU Council Presidency translator' web application. The interface is dark-themed with a blue header. The header contains the 'eu2020.de' logo on the left, the title 'EU Council Presidency translator' in the center, and 'Log in' and a globe icon on the right. Below the header, the main content area is divided into two columns. The left column is labeled 'From:' and has a dropdown menu with 'German', 'English', and 'Bulgarian'. Below this is a large text input area with the placeholder text 'Enter the text or homepage address you would like to translate.' and an 'Upload or drag a file' button at the bottom. The right column is labeled 'To:' and has a dropdown menu with 'English', 'French', and 'Spanish'. Below this is a large text output area containing the text 'Machine translation results help to understand the meaning of a source text, but do not equal translation by a human.' and 'Machine Translation provided by DFKI' at the bottom. A 'Provider:' dropdown menu is set to 'DFKI', and a 'Translate' button is located to its right. At the bottom of the page, there are logos for Tilde, DFKI, and DeepL, along with the text 'Solution developed by Tilde. Machine Translation provided by DeepL, DFKI, eTranslation, Tilde.' and a footer with links for 'Privacy', 'Terms of use', 'FAQ', 'About', and 'Send feedback'.



## 2020/21 Selected Papers

- Ruitter et. al. Integrating Unsupervised Data Generation into Self-Supervised Neural Machine Translation for Low-Resource Languages. [MT Summit 2021](#)
- Adelani et al. The Effect of Domain and Diacritics in Yoruba--English Neural Machine Translation. [MT Summit 2021](#)
- Jamara et. al. Mid-Air Hand Gestures for Post-Editing of Machine Translation. [ACL-IJCNLP 2021](#).
- Xu et al. Modelling Task-Aware MIMO Cardinality for Efficient Multilingual Neural Machine Translation. [ACL-IJCNLP 2021](#).
- Xu et al. Multi-Head Highly Parallelized LSTM Decoder for Neural Machine Translation. [ACL-IJCNLP 2021](#).
- Zhang et al. A Bidirectional Neural Translation Model for Learning Word Alignment. [ACL-IJCNLP 2021](#).
- Xu et al. Probing Word Translations in the Transformer and Trading Decoder for Encoder Layers. [NAACL-HLT 2021](#).
- Chowdhury et al. Understanding Translationese in Multi-View Embedding Spaces. [COLING 2020](#).
- Pal et al. The Transference Architecture for Automatic Post-Editing. [COLING 2020](#).
- Ruitter et al. Self-Induced Curriculum Learning in Self-Supervised Neural Machine Translation. [EMNLP-2020](#).
- Zhang et al. Translation Quality Estimation by Jointly Learning to Score and Rank. [EMNLP 2020](#).

## 2020/21 Selected Papers

- Xu et al. Dynamically Adjusting Transformer Batch Size by Monitoring Gradient Direction Change. [ACL 2020](#).
- Xu et al. Learning Source Phrase Representations for Neural Machine Translation. [ACL 2020](#).
- Xu et al. Lipschitz Constrained Parameter Initialization for Deep Transformers. [ACL 2020](#).
- Herbig et al. MMPE: A Multi-Modal Interface for Post-Editing Machine Translation. [ACL 2020](#).
- Herbig et al. MMPE: A Multi-Modal Interface using Handwriting, Touch Reordering and Speech Commands for Post-Editing Machine Translation. [ACL 2020](#).
- Alabi et al. Massive vs. Curated Embeddings for Low-Resourced Languages: the Case of Yorùbá and Twi. [LREC 2020](#).
- Costa-jussà et al. Multilingual and Interlingual Semantic Representations for Natural Language Processing: A Brief Introduction. In: [Computational Linguistics](#) (CL) Special Issue: Multilingual and Interlingual Semantic Representations for Natural Language Processing.
- Xu et al. Efficient Context-Aware Neural Machine Translation with Layer-Wise Weighting and Input-Aware Gating. [IJCAI 2020](#)

- Jamara et. al. Mid-Air Hand Gestures for Post-Editing of Machine Translation. [ACL-IJCNLP 2021](#).
- Herbig et al. MMPE: A Multi-Modal Interface for Post-Editing Machine Translation. [ACL 2020](#).
- Herbig et al. MMPE: A Multi-Modal Interface using Handwriting, Touch Reordering and Speech Commands for Post-Editing Machine Translation. [ACL 2020](#).
- Herbig et al. Multi-modal Approaches For Post-editing Machine Translation. [CHI 2019](#)



# Titel